FEBRUARY 1954

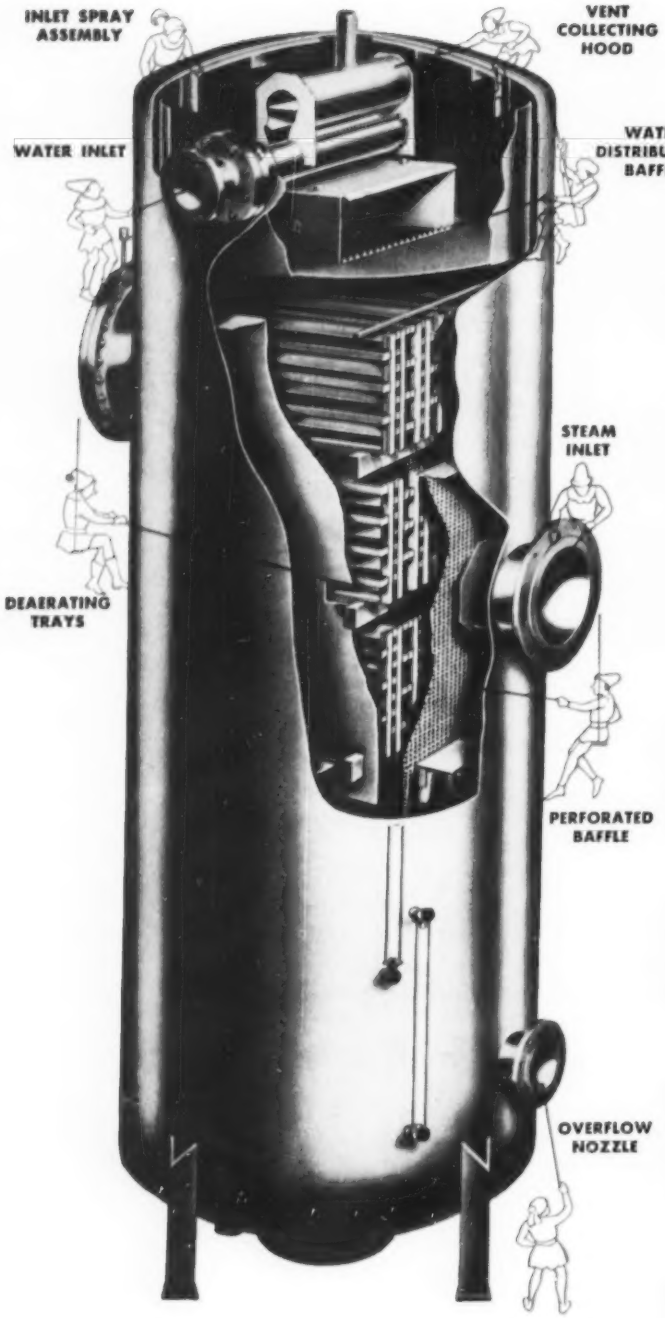
Circulation of this issue..... 33,478

Power Engineering

Power Plant Safety:—Lift It Right. . . . Don't Strain Yourself 57
Automatically-Regulated Capacitance for Power Factor Control 58
Does Your Plant Make Too Much Noise? 62
Slag-Blowing Pointers for Power Plant Operators 65
SARA Keeps Watch at Three TVA Steam Plants 66
What "Explosion-Proof" Really Means in Electrical Equipment 69
Pointers on the Conservation of Fuel, Heat and Energy 72
Level Measurement and Control Methods—Take Your Pick from These 74
Steam Alone Powers New System Using Unit Heaters 77
Pipe Sizing Charts . . . Quick and Accurate, to Save Your Figuring Time 78
Proper Coatings Just as Important for Fiber Materials as for Metals 80
Treatment of Cooling Waters for Various Power Plant Uses 82
How to Make Flash Steam Calculations 85
Metering and Cost Control Keep State Power Plant on Cash Basis 86
How to Figure Air-Cooled Steam Condenser 88
What You Need on Boiler Feed Pump Bearing Maintenance 90

REGULAR DEPARTMENTS

Engineers' Preview..... 3
Editorial and Business Staff..... 3
Helpful Bulletins..... 23
Equipment News..... 36
Construction News..... 42
News Reel..... 70
Practical Engineer and Electrician..... 92
New Engineering Books..... 114
Readers' Service Post Cards..... 129
Advertisers' Index..... 148



They tailor in steel at Elliott for ELLIOTT DEAERATING FEEDWATER HEATERS

An Elliott deaerating heater of multiple tray type. In this latest design the traditional tube-type vent condenser is replaced by a stainless steel vent collecting hood, located inside the shell at top, with the inlet spray assembly just below it. This design saves headroom and requires no maintenance beyond routine inspection.

All through this unit, stainless steel is used wherever there is contact with corrosive water. The trays, formerly of cast iron, are of fabricated stainless steel, light in weight and easily handled.

ELLIOTT

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS •

DEAERATOR AND

N3-2

Rolling the shell of a deaerating heater to gage, on a large capacity bending roll.

It reminds one of the Lilliputians making a suit of clothes for the famous Gulliver, to see Elliott welders, bending roll operators and others doing the mammoth tailoring job required in building big Elliott deaerating heaters and their storage tanks.

The whole job is done in the Elliott works, assuring no deviation from Elliott quality, no sharing of responsibility with any outside source. When you get an Elliott deaerating heater you know it's *all* Elliott, product of the organization which 35 years ago was first to conceive the process of removing corrosion-causing dissolved oxygen from feedwater, and which pioneered the equipment to do it. With a start like this, Elliott deaerating heaters easily maintain their lead in design for performance and ease of maintenance.

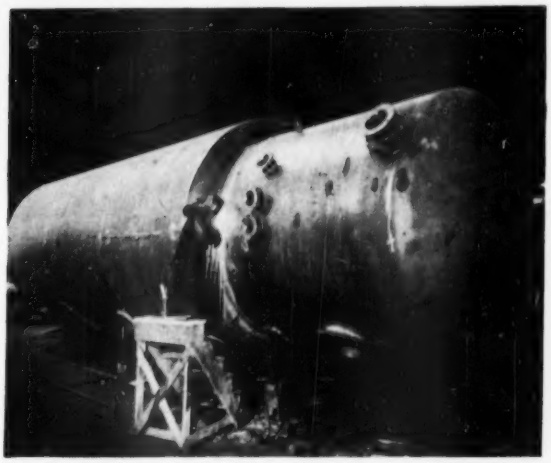
For bulletins and full details on Elliott deaerating heaters, contact your local Elliott representative or district office, or write Elliott Company, Jeannette, Pa.

Company

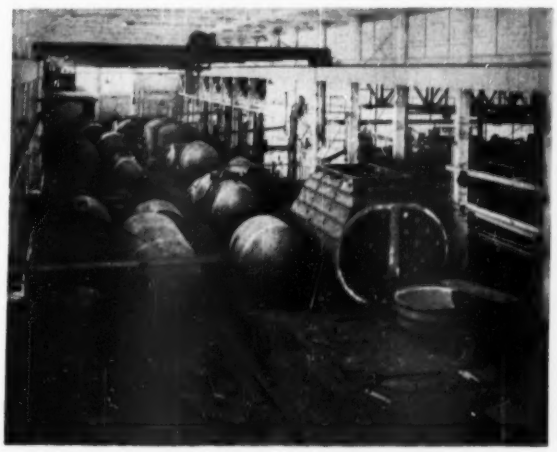
CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

HEATER DEPARTMENT

Trimming the edge of a head for a storage tank with an acetylene torch machine. In the background is the shell of a storage tank ready for automatic welding of girth and longitudinal joints.



Welding the bottom of a deaerating heater to the top of its storage tank for vertical installation. All units are built to fit the specific conditions of allowable space as well as of performance required.

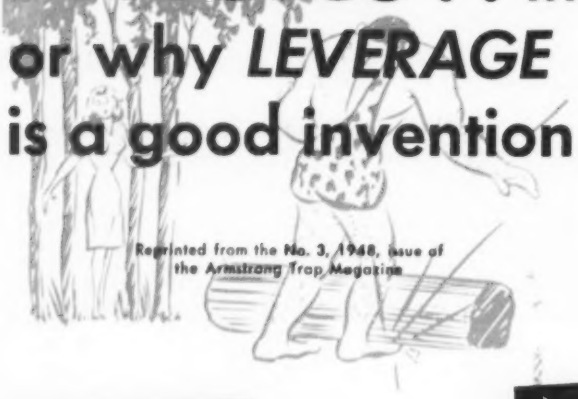


Assembly floor in the Elliott welding shop. After assembly, each unit is brought to the test floor for hydrostatic test, then transferred to a flatcar for shipment.

For more data circle 501 on Post Card

PHYSICS . . In one easy lesson

or why *LEVERAGE* is a good invention



Reprinted from the No. 3, 1948, issue of the Armstrong Trap Magazine

A BURLY giant, whom we shall call Dullbottom for lack of a more descriptive name, was amusing himself in the Petrified Forest one warm July afternoon. Entranced by the many colorful and giant-sized playthings there, he was happily engaged in rolling petrified logs down a small incline when one toppled onto his toe. Despite his most persistent efforts he was unable to dislodge this log, later calculated by Unimpeachable Authorities to weigh 1,000 lbs.

Dullbottom's gruntings and groanings attracted a petite and pretty Physics teacher who (fortunately for our story) was strolling in the vicinity. It took her but a glance to grasp the situation and, without hesitation, she obtained a crowbar from a convenient source of supply, applied LEVERAGE to the log and freed the giant's giant toe.

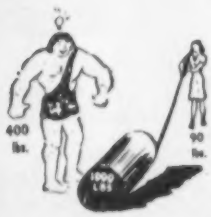
Completely befuddled by the powers of his 90 lb. benefactor, but clumsily grateful, he asked to feel her muscle, a request which was instantly refused. Instead, the young lady offered to explain the fundamentals of LEVERAGE. Delighted by her explanation, that given sufficient LEVERAGE, she could move any weight, Dullbottom immediately proceeded to roll a 4,000 lb. petrified log onto his other foot.

With the infinite patience acquired from dealing with adolescents in the classroom, our pretty Miss obligingly procured another crowbar four times as long as the first and proceeded to move the weight—BUT, much to the dismay of Dullbottom, only ¼ as far, which was, sad to relate, not far enough to free his toe.

And, thereby, hangs a tale. Let's use this little flight of fantasy to explain a fundamental reason why Armstrong steam traps have such large capacity for their size. Please refer to diagrams on the blackboard.

The Fairy Story

1. All Brawn . . . No Brains



2. Science to the Rescue

3. Stupidity Triumphant

No Leverage

To open a 1-1/16" orifice at 15 psi, a steam trap without leverage would require a bucket weighing 19-1/2 lbs. and displacing 29-1/4 lbs. of water. A trap big enough to hold this bucket would weigh somewhere near 300 lbs. At 250 psi, the largest orifice this trap could open would be 9/32".

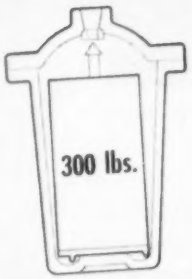
Correct Leverage

Contrast the No-Lever Trap with an Armstrong No. 216 weighing about 1/4 as much . . . 80 lbs. It also opens a 1-1/16" orifice at 15 psi and will open a 3/8" orifice wide at 250 psi — nearly 80% greater than that of the No-Lever Trap. Result of CORRECT LEVERAGE: less weight, less radiation, lower price trap, less installation cost, greater capacity.

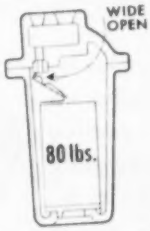
Too Much Leverage

Here's an 80 lb. trap with leverage double that of the No. 216 Armstrong described above. It will open an appreciably larger orifice at any given pressure than the standard Armstrong No. 216. *But, it won't open the valve wide!* There isn't room to get the valve completely away from its seat. Flow through the orifice is thereby restricted and capacity is reduced below that of the No. 216. The larger orifice and the greater leverage is a total loss! To get the valve wide open would require a bigger trap.

The Real Thing



Get Results . . . But Impractical



Efficiency, Economy

Misapplied Science

Size for Size, Armstrongs have greater capacity because the correct application of high leverage permits the full opening of a large orifice!

ARMSTRONG MACHINE WORKS
810 Maple Street
Three Rivers, Michigan

Send for Catalog

ARMSTRONG STEAM TRAPS

For more data circle 502 on Post Card

ENGINEERS' PREVIEW

AN INTERESTING power-hands-across-the-sea, or rather across the Detroit River, has recently been carried out. This is an interconnection between the Ontario Hydro-electric Commission and the Detroit Edison Company. It is described in considerable detail in the November *Synchroscope*. Two high river-crossing transmission lines have been built from the Delray and Marysville plants and each has a capacity of 150,000-kw. Special amendment to the Federal Power Act had to be made to carry out this plan.

* * *

A MAGNETIC TAPE for directing a machine or process cycle from information stored on the tape is being built by the G-E Specialty Control Department for a machine tool company. The industrial-type multiple-channel tape recorder used in the control is similar to equipment employed in the entertainment and broadcasting fields, except that it records motion instead of sound. It serves as a magnetic memory for the machine on which it is installed.

* * *

ENGINEERS should "try to break into print as often as possible," was the advice recently given to a professional group in Philadelphia by Kenneth E. Trombley, Editor of the *American Engineer* and public relations director of the National Society of Professional Engineers.

"I don't care how busy you are. Write and write often, for your own good and the good of the profession," said Mr. Trombley, who was the chief speaker at an "Authors' Night" dinner attended by engineers of the Kuljian Corp., of Philadelphia, at the Warwick Hotel.

"You must meet the responsibilities of professional men by writing to share your technical know-how," he continued. "The tremendous strides made by American industry can be credited in large part to the free exchange of information made possible by our highly developed trade press, and by engineers willing to devote part of their time to writing."

Among other speakers at the dinner were Col. John Vassos, noted industrial designer and consultant to the Radio Corporation of America; Andrew W. Kramer, editor of POWER ENGINEERING; James L. Cherry, executive vice president, and Arthur H. Kuljian, vice president — engineering, of the Kuljian Corp.

* * *

DUQUESNE LIGHT Company and Walter Kidde Nuclear Laboratories, Inc. have entered an agreement with the Atomic Energy Commission to undertake jointly a study of the engineering and economic feasibility of producing electric power for atomic energy. Thus, another team is added to the group already working on the subject, as noted in our June 1953 issue.

* * *

SECOND Basic Materials Exposition will be held at the International Amphitheatre, Chicago, May 17-20, 1954. Exhibits are those of companies producing the basic materials that go into the making of other products. Manufacturers of end products and equipment producers may attend only as visitors. The Exposition will be held concurrently with a Basic Materials Conference.

* * *

ENGINEERING INSTITUTES conducted by the University of Wisconsin are doing a good job of teaching old dogs — and some young ones — new tricks. Designed to help engineers and technicians from all branches of industry, these institutes offer programs of particular interest to power engineers. Subjects dealt with in the 1953-

EDITORIAL AND BUSINESS STAFF

POWER ENGINEERING IS PUBLISHED MONTHLY • 110 S. DEARBORN ST., CHICAGO 3, ILL. DEARBORN 2-5446

EDITORIAL AND ART STAFF

Editorial Director — Richard H. Morris
Editor — Andrew W. Kramer
Managing Editor — Chester R. Earle
Associate Editor — Norman S. Jones
Associate Editor — Robert J. Mitchell
Equipment Editor — Marian E. Heniken
Editorial Assistant — Irene M. Glen
Staff Artist — James E. Wilcox
Chief Draftsman — Robert W. Koster

OFFICERS AND BUSINESS STAFF

President — Kingsley L. Rice
Executive Vice President — Edwin C. Prouty
Vice President — Walter Painter
Vice President in Charge of Sales — Richard M. Ward
Treasurer — Arthur L. Rice, Jr.
Assistant Treasurer — Thomas Walsh
Secretary — Edwin C. Prouty, Jr.
Production Director — John O. Aarvold
Production Manager — Earl R. Noren

Technical Publishing Company is incorporated under the laws of the State of Illinois. Board of Directors: Kingsley L. Rice, Arthur L. Rice, Jr.; Andrew W. Kramer, Edwin C. Prouty, Richard H. Morris.

ADVERTISING SALES STAFF

Vice President in Charge of Sales — Richard M. Ward

DISTRICT MANAGERS

Boston 16, Mass. 258 Park Square Bldg — Edmund J. Shea, HAncock 6-4639
New York 17, N. Y. 1613 Graybar Bldg. — Richard Y. Fuller, MUrray Hill 5-3779
Philadelphia, Pa. 1235 Jericho Road (Abington, Pa.) — Oscar Wilds, Ogontz 6843-W
Pittsburgh 19, Pa. 404 Frick Bldg. — James B. Tafel, COurt 1-4878
Cleveland Heights, O. 2945 Fairmount Blvd. — Richard M. Ward, F. Allen Schmidt, FAirmount 1-0616
Chicago 3, Ill. 110 S. Dearborn St. — Walter Painter, Warren F. Saas, DEarborn 2-5446

WEST AND SOUTHWEST

McDonald-Thompson offices: Seattle 4, Wash., Harry Abney, 1008 Western Ave., Elliott 3767; San Francisco 5, Cal., Les Meek, 615 Market St., YUkon 6-0647; Los Angeles 5, Cal., Connie J. Grabb, 3727 West Sixth Street, DUnkirk 7-5391; Denver 2, Colo., Robert Heidersbach, 222 Colorado National Bank Building, Keystone 4669; Houston 6, Texas, Frank Vickery, Room 214, 3214 Montrose Blvd., LYnchburg 6711.

Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, in other countries $12 per year; single copies $1.00.

Micro film edition $4.75 annually from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Copyright 1954 by Technical Publishing Co. Acceptance under Section 34.64 P. L. & R., authorized publication office at Concord, N. H.

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

NEW BOILER WATER CONDITIONING PACKAGE

Adjust-O-Feeder
Model 1105-S

- LOW COST
- COMPACT
  Built-in standard motor—no separate gearbox or couplings.
  Built-in oil-enclosed gear reducer.
- MICRO-STROKE ADJUSTMENT
  Scale easily read—crank and connecting rod operate in horizontal plane.
- LONG LIFE AND EASY MAINTENANCE
  One-piece Meehanite iron frame for positive alignment of all moving parts.
  Double check valves on suction and discharge easily removable.

This new, compact chemical feed pump, by %Proportioneers, Inc.%, is inexpensive and provides accurate boiler water treatment for plants where a low capacity, medium pressure pump will meet requirements. The standard Model 1105-S has a capacity range from 1 to 10 GPH and will discharge against pressures up to 650 psig. For lower feeds, the unit is available with a range of from 0.5 to 5 GPH. Complete and self-contained, Model 1105-S weighs less than 100 lbs. and is ready to operate.

Ask for Bulletin 1105

%PROPORTIONEERS, INC.%

Write to %PROPORTIONEERS, INC.%, 385 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

For more data circle 503 on Post Card

1954 sessions included: Diesel operation, automatic process control, steam plant operation, economics of construction, plant maintenance, industrial waste problems, industrial instrumentation, corrosion control, power system protection, atomic energy, and warm-air heating. The rest of their program and schedule can be obtained by writing to Paul J. Grogan, Director of Engineering Institutes, University of Wisconsin, Madison 6, Wis.

We were impressed by the quality of material offered during a recent visit, and we particularly liked the easy communication between the speakers and audience.

* * *

JAMES W. PARKER, formerly president of The Detroit Edison Company, is now associated as senior consultant in engineering and management with the firm of Boddy, Benjamin and Woodhouse, Inc. at 28 W. Adams Ave., Detroit 26, Mich.

* * *

FREDERICK S. MALLETTE, executive secretary of the Committee on Air Pollution Controls and staff member of The American Society of Mechanical Engineers, has been invited to give a Clayton Lecture on air pollution before the Institution of Mechanical Engineers of Great Britain and London on April 23, 1954.

* * *

NUTS AND VOLTS now go together just as well as nuts and bolts — and after that horrible pun, the significance of which you will soon see, we wish to have no more wise-cracking about nuts. Instead, we wish to report that electric power, with which every reader of POWER ENGINEERING is intimately concerned, has now been harnessed for cracking walnuts. And if that's a wise-crack, make the most of it!

All kidding aside, nut crackers have found that a 65,000-v, 5000-amp bolt of electricity will take the shell off a walnut clean as a whistle. It does not damage the kernels, more than doubles production.

In a special machine, the nuts are grasped by movable electrodes and held for an instant while the big lightning bolt shatters the shell. Then meat and shells drop into an underground conveyor that carries them to be sorted and packed. According to *Popular Science Monthly* this electrical nutcracker was developed by the Northwest Nut Growers of Portland, Ore.

* * *

RICHARD H. MORRIS, editorial director of POWER ENGINEERING and its companion magazine, *Plant Engineering*, was elected secretary-treasurer of the Society of Business Magazine Editors for 1954. At the same meeting, Frank P. Tighe, editor of *Motor Age*, was elected second vice president; William A. Richardson, editor of *Medical Economics*, first vice president; and Walter J. Murphy, editor of *Chemical & Engineering News*, president. The SBME is a national professional organization of senior editors of 150 professional and technical magazines with a total circulation of over 2,500,000. Its purpose is to promote high editorial standards and help industrial magazines better serve their respective fields. The first president and present secretary of the Executive Committee is Paul Wooton, dean of Washington correspondents. The symbol of the society, the Circle and Quill, appears on our masthead, page 3.

YOU MAY EXPECT to see and hear reports of strong agitation for limitation of foreign petroleum imports in the immediate future, if we can judge from statements of both the petroleum and the coal industries. The petroleum industry itself is not agreed on this subject — in fact, some engineers say the whole oil industry is split right down the middle on it. The potential inflow of oil from abroad is a billion-barrel-a-day headache. The issue popped up during the APE meeting in Chicago and it will be echoed in the present session of the Congress. The argument, according to the *York Report*, will get hotter than a well on fire.

Not only that, but the coal people will get into the act. They are losing business to both the oil and the gas industries even though coal still is and will remain the dominant basic fuel for the entire country.

There is always the question, of course, as to how much oil we must import for purely political reasons. Another point, raised by several of our engineer friends, is that the coal people don't need to worry too much in view of the troubles we are having with some of the imported oil due to its vanadium and sodium components. Even though it is cheap, it

Want An Atomic Power Poster?

THIS 27-by-36-in. colored poster of an atomic power plant will be sent to readers of POWER ENGINEERING who write for it on their company letterhead. It was designed originally for distribution to public utility companies. We have a limited number of copies available for general distribution. Merely ask for it on your company letterhead and we will mail a copy to you, free. First come, first served.

.....and now ATOMIC POWER for PEACE
STEAM
HIGH VOLTAGE SWITCH YARD
TURBINE
ELECTRIC GENERATOR
STEAM GENERATOR
CONTROL BOARD
NUCLEAR REACTOR
COOLANT PUMPS
The U. S. Atomic Energy Commission Plans to Build the First Commercial Size Nuclear Power Plant to Produce Electricity
The Investor-Owned Utility Industry is Invited to Invest Risk Capital in the Building of the Steam and Turbine Portions as well as the Operation of the Entire Plant

may be raising maintenance costs high enough to counterbalance its lower first cost.

Fact is, we were recently in one large central station that tried to burn some of this imported oil and at the end of two weeks had to give it up and shift back to pulverized coal. It was stated they would not go back to the imported heavy oils, but if they had to use oil for emergency or standby firing, they would have to get some diesel oil.

Anyway, the fur is going to fly and we are in the position of the farmer up the tree with the bear chasing his wife around the tree down below and the farmer yelling, "Go it, wife — go it, b'ar!"

* * *

ALFRED D. BLAKE retired from duty as editor of *Combustion* magazine as of December 1 last. He is succeeded as editor by Joseph C. McCabe, formerly associate editor of *Power*. Glenn Fryling, able associate of Mr. Blake for five years, will continue as Mr. McCabe's associate.

This bald statement of facts serves only to introduce our expression of regret at seeing Mr. Blake leave the field of friendly competition and pleasant personal relations that we and other magazines in the industry have enjoyed with him for 20 years. During that time, the power industry has gone through a period of unprecedented progress, especially in steam power, and *Combustion* has been in the forefront of those who have recorded and interpreted it. With the complete support and cooperation of his company, Mr. Blake has made *Combustion* an internationally-recognized magazine in the field of steam engineering.

Under the guidance of the new team of McCabe and Fryling, we are sure it will continue to maintain that position. Mr. McCabe has been for eight years in close touch with the developments in steam generation, fuels and firing, feedwater treatment and related topics. We wish him all success as the new editor of *Combustion*, carrying on the fine work of Mr. Blake, who promises to watch from the sidelines with keen interest the further progress in power generation.

* * *

DETAILED description of the work of Ford, Bacon & Davis, in design construction, management, industrial engineering, reports and valuations is given in a new 12-page bulletin. For copies write the company at 19 Broadway, N. Y. 6, N. Y.

* * *

SARGENT & LUNDY, Consulting Engineers, 140 S. Dearborn St., Chicago, Ill., announce the retirement of Ludwig Skog, Senior Partner, as of December 31, 1953.

Ludwig Skog

Mr. Skog was born and educated in Norway, receiving his mechanical engineering degree from Trondheim Polytechnic Institute in 1909. He joined the staff of Sargent & Lundy in 1910 and became Senior Partner in 1947.

Mr. Skog is widely known in engineering circles and is considered one of the outstanding electric power station design engineers in the country. He is a Fellow of the ASME, a member of the American Society for Testing Materials, American Welding Society and has been a member of the Board of the Western Society of Engineers. He is a member of the Board of Trustees of the Illinois Institute of Technology and a member of the Executive Committee of the Armour Research Foundation. He is also a member of the Union League Club, the Chicago Club and the Norwegian Club.

Alf Kolflat

A. Kolflat, who joined the firm of Sargent & Lundy in 1925, has been appointed Senior Partner to succeed Mr. Skog.

ANDREW W. KRAMER, editor of POWER ENGINEERING, attended the launching of the *U.S.S. Nautilus*, first nuclear-powered submarine, on January 21 at Groton, Conn., by special invitation of the chairman and board of directors of General Dynamics Corp. The launching was sponsored by Mrs. Dwight D. Eisenhower.

Completion of the vessel marks an important occasion in the great story of power development. It is highly important from the military point of view, of course; but to the EP editor, its connotations for peace-time uses of power seem even more important.

Nautilus will be propelled by the first practical, working nuclear energy power plant ever to be built. But that same power plant could be used just as well in a stationary installation ashore for the production of electric power, in the same way that a diesel engine in a vessel is fundamentally the same diesel as is used ashore, except for details. Fact is, the prototype of the submarine power plant was developed and operated hundreds of miles inland at the AEC laboratory in Idaho.

Mr. Kramer, as a member of the Committee on Industrial Information of AEC, knows what can be said about the *Nautilus* and her power plant and you will see his report on the launching in an early issue.

* * *

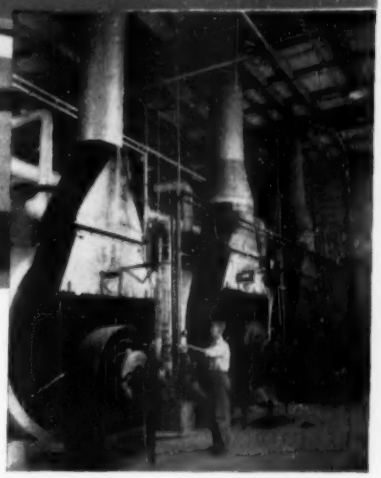
DON ALLSHOUSE has been appointed general advertising manager of Continental Foundry & Machine Co. He has been advertising manager of the Copes-Vulcan division of Continental since its formation in June 1952. Previously he served as advertising manager of Northern Equipment Co. from 1928 until the company was purchased by Continental and later consolidated with Vulcan Soot Blower Corp. to form the Copes-Vulcan division at Erie, Pa. Mr. Allshouse's new duties will be to direct all advertising for both Continental and Copes-Vulcan.

* * *

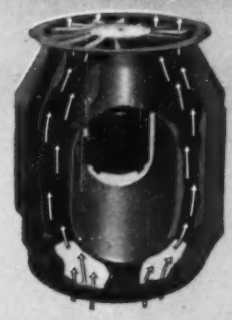
WETTER WATER

While kingdoms fall and temples totter
They're busy making wetter water.
Of all the liquids they could better
They go and make the water wetter.
(*The Betz Indicator*) ANON.

CONSTANT BOILER DRAFT
at 1/3 the cost of a brick stack



ABOVE: Mounted on the roof at Viroqua Co-op Creamery, Viroqua, Wisconsin, are two 2-stage Induced Draft Bifurcators, each with 27" fan wheel and 3 HP open drip-proof motor, and one 2-stage Induced Draft Bifurcator with 24" fan wheel and 2 HP open drip-proof motor. All have motor chamber weather louvers.



HOW BIFURCATOR FAN WORKS

The Induced Draft Bifurcator is a direct motor driven fan in a divided housing. The motor is in an isolated chamber around which the flue gases are by-passed. Thus the motor always remains cool, clean and easily accessible. Induced Draft Bifurcators are available with fan wheels from 12" through 36" in diameter, for high pressure boilers delivering up to 60,000 pounds of steam per hour and for low pressure boilers delivering up to 190,000 EDR.

If you have a difficult stack problem, read what Sylvan Dregne, manager of the Viroqua Co-op Creamery, says:

"We have two 200 and one 125 HP oil-fired boilers. During our busy season, we use two boilers for about 15 hours a day, 7 days a week and the one boiler for about 5 hours more after the peak load is over. We installed the Bifurcator Fans in September, 1951, and we have used them since then without any service required. They have proved to be very satisfactory, and they maintain a constant draft regardless of weather conditions. We installed these fans for approximately 1/3 the cost of a suitable brick stack."

How much can YOU save by installing Induced Draft Bifurcator Fans? Ask your DeBothezat representative or write our factory for details. Address Dept. PO-254.

DeBothezat Fans

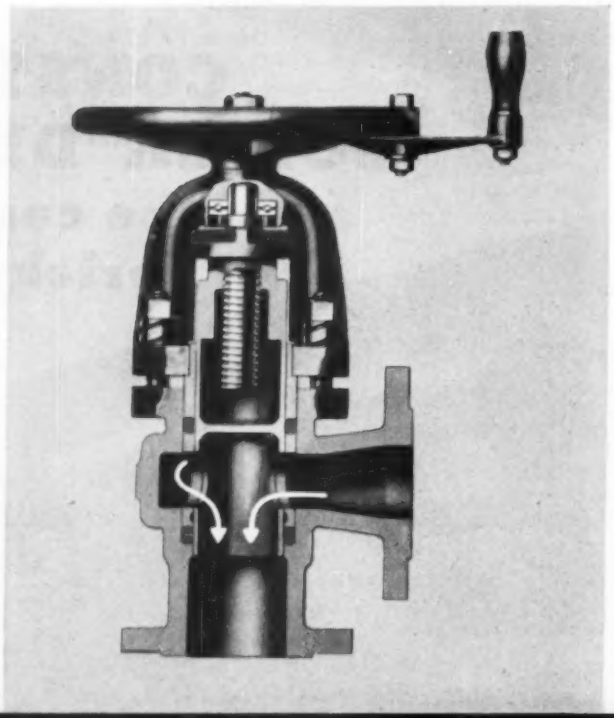
Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

For more data circle 504 on Post Card

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

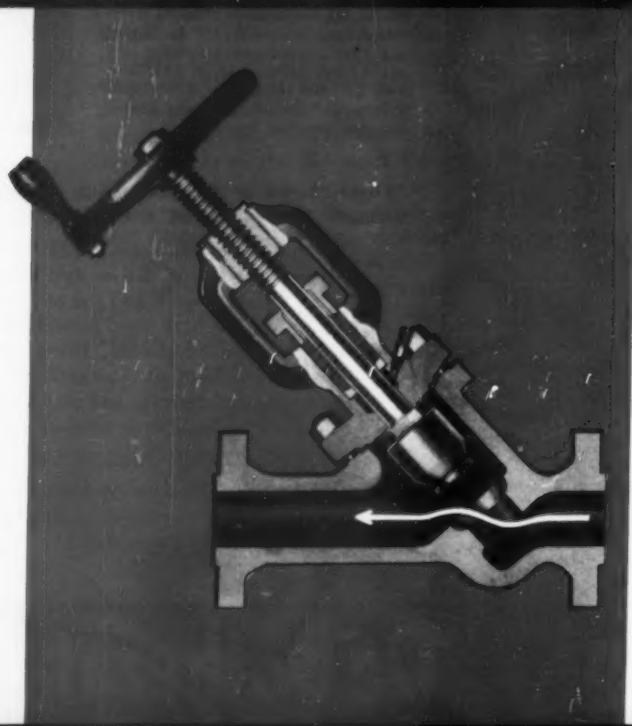
Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.



FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

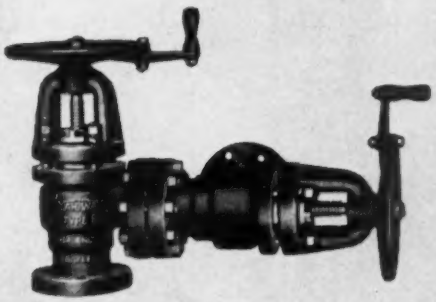
■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

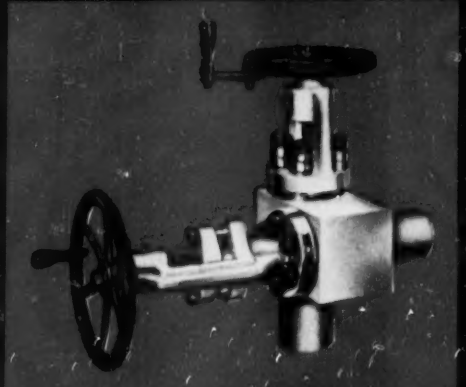


• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the cooling valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless cooling valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

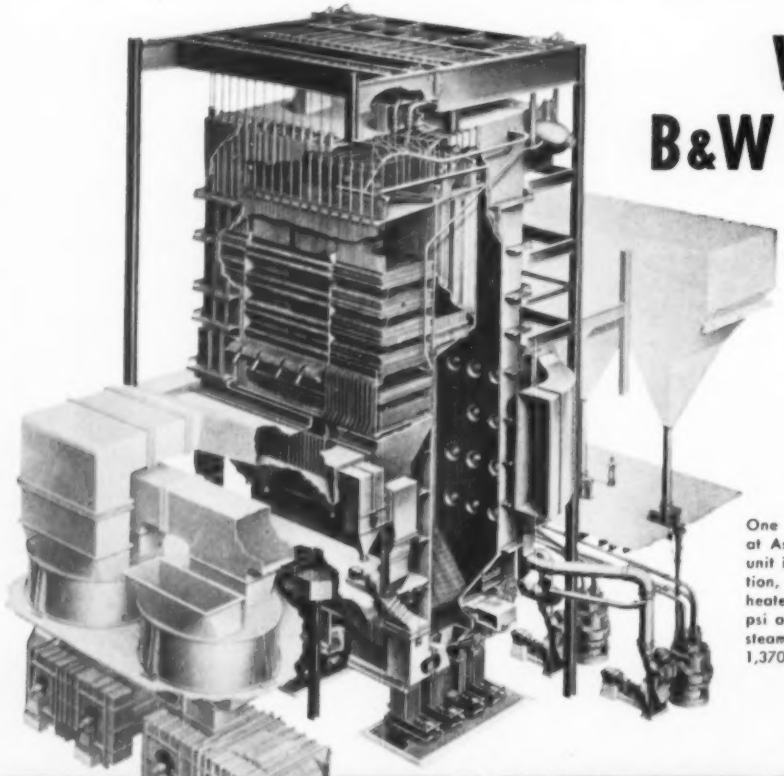
YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

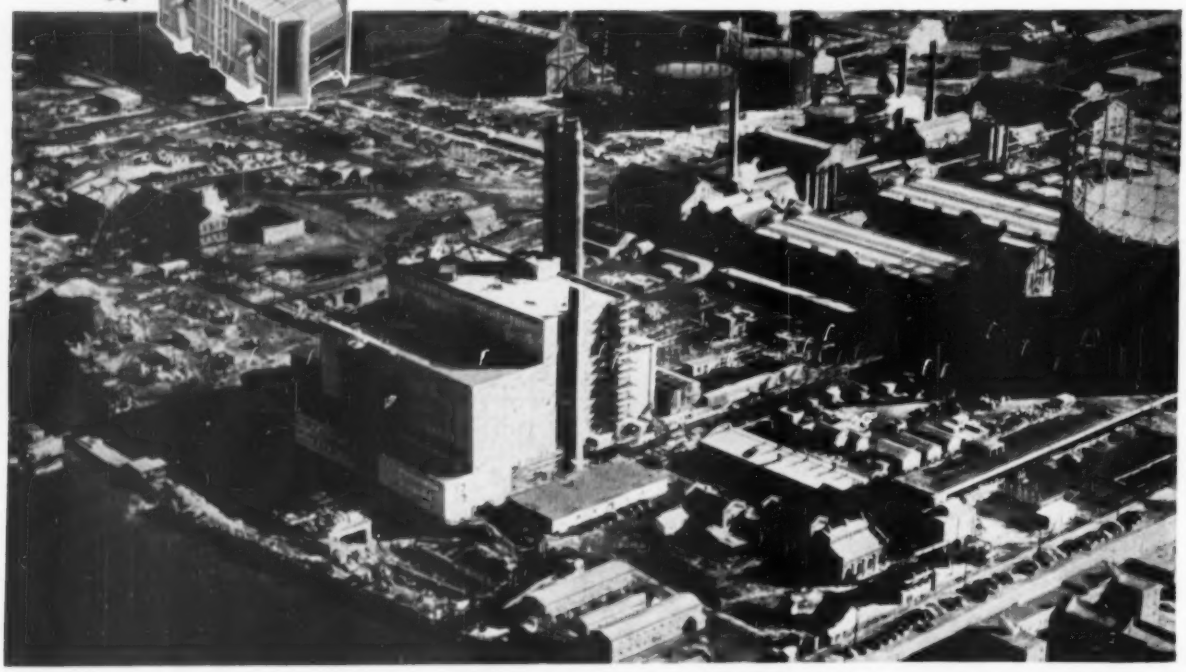
blow-off valves

Astoria Station

With More B&W Pressure-Fired Boilers



One of two Pressure-Fired B&W Boilers installed at Astoria. This dry-bottom, Radiant Reheat Type unit incorporating B&W Divided-Furnace construction, has a design pressure of 2050 psi. Superheater outlet pressure and temperature are 1850 psi and 1000 F, with reheat to 1000 F. Designed steam output ranges between 1,200,000 and 1,370,000 lb per hr, depending upon type of fuel.



Astoria Generating Station of Consolidated Edison Co. which will ultimately have a generating capacity of about 1,000,000 kw.

Goes on the Line

New from foundations to stacks, Astoria Station of the Consolidated Edison Co. of New York, Inc. represents a considerable advance in steam-electric power generating facilities. Significant features of this modern station include Pressure-Firing, one boiler-per-turbine, Cyclone Steam Separators for natural circulation, extra-fast starting of boiler and turbine, above-normal-capacity auxiliaries, and automatic shut-down protection.

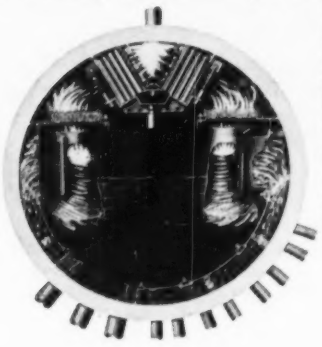
Pressure-Fired Boilers

The two Pressure-Fired B&W Boilers are the largest units in the world without induced draft fans. Pressure-Firing was selected for this station on the basis of service-proved economies and advantages. These include:

1. Greater efficiency due to elimination of air infiltration with consequently lower stack loss.
2. Elimination of cost of induced draft fans with attendant controls, foundations, and ducts.
3. Savings in installed kilowatts for auxiliaries.
4. Savings in operating power needed for fans.
5. Reduced maintenance due to elimination of induced draft fans.
6. Smoother operation, simpler controls, and easier starting with only forced draft fans.

Natural Circulation with Cyclone Steam Separators

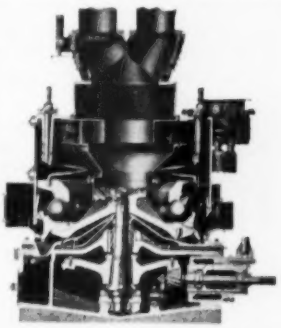
B&W Cyclone Steam Separators in the steam drum do a two-fold job. Separation of circulating water from steam is virtually one hundred per cent, thus assuring a high circulating head at all times. In addition, the Cyclones, in conjunction with steam scrubbers, help maintain turbine efficiency and reduce turbine maintenance by delivering steam of extremely high purity.



Building Saving with Divided-Furnace Construction

The simple B&W Divided-Furnace construction makes it feasible to achieve the required furnace cooling surface without an excessive increase in building volume. Substantial savings in steel work and other structural components are made possible.

Type EL Pulverizers and Multi-Fuel Burners



Each unit is served by five B&W Type EL Pulverizers which utilize the ball bearing principle of grinding. There are 22 circular burners suitable for use with oil, gas, or coal on each unit. Low maintenance is an outstanding feature of the EL Pulverizer which has long-life grinding elements made of a special abrasion-resistant material. Designed for ease of operation and simplified control, this design of pulverizer satisfies every requirement for economical, efficient direct-firing of pulverized coal.

* * * * * * * * * * * *

These and many other B&W engineering advances developed to increase the efficiency of steam generation are providing satisfactory and economical central-station and industrial service in plants across the country.

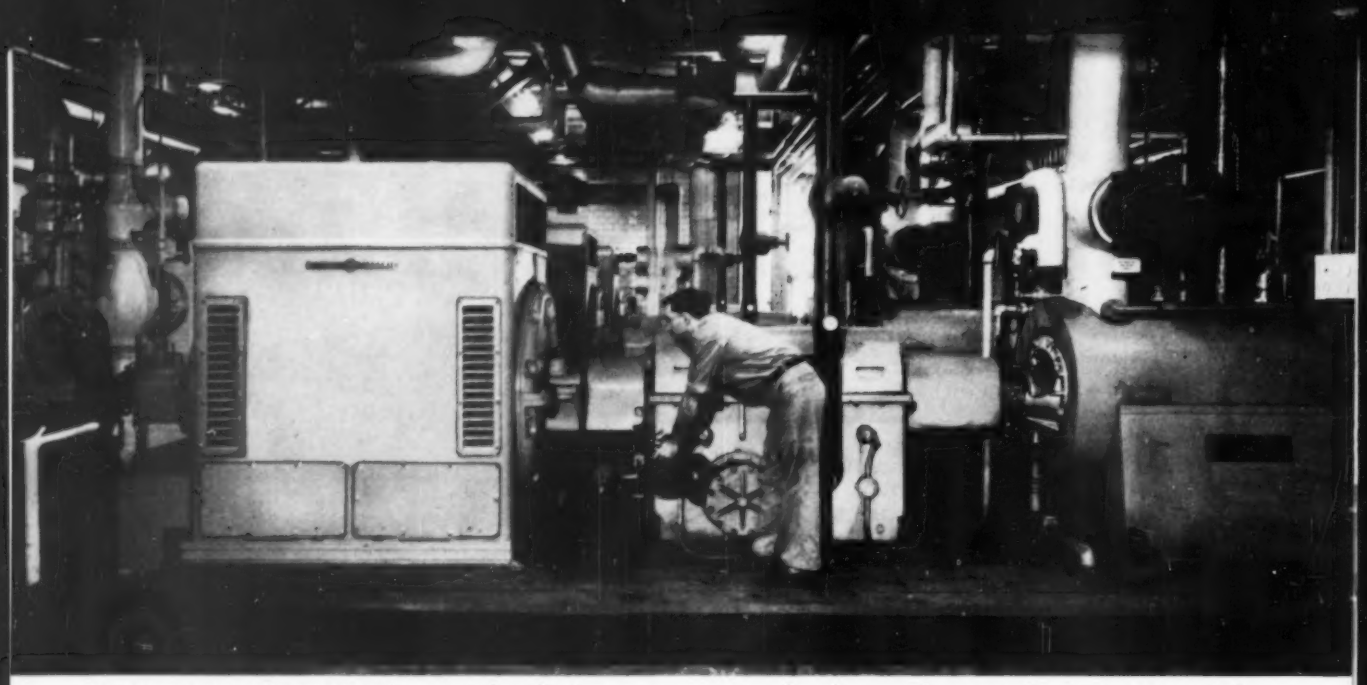
We will be glad to discuss them in terms of your future plans for boiler replacements or additional plant. For a detailed description of the features incorporated in Consolidated Edison's new Astoria Station, write for Bulletin 3-560. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

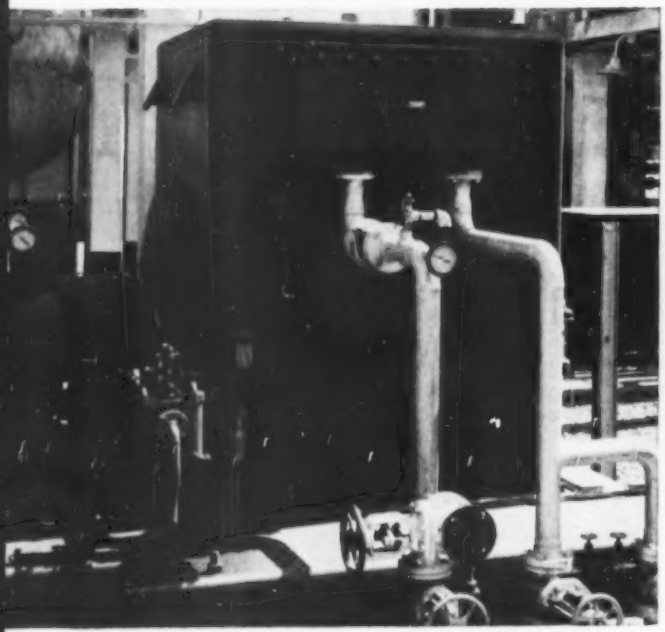
G-620

For more data circle 506 on Post Card

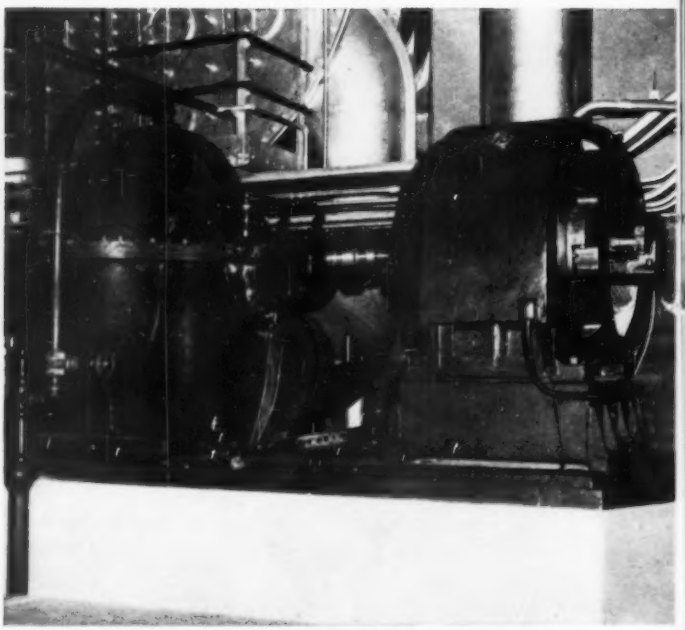


G-E BOILER FEED PUMP MOTORS in a typical application at Detroit Edison's Connor's Creek Plant. Designed especially for boiler feed pump service, 1000 hp ratings and larger, this motor permits closer spacing because of unique ventilating system and cubical shape . . . conserves floor space. You get improved performance from streamlined rotor design which also gives quieter operation. Dual lubrication system combines the advantages of force-flood lubrication and self-lubricated oil rings. Modern appearance blends with power station styling. Write for Bulletin GEA-5813.

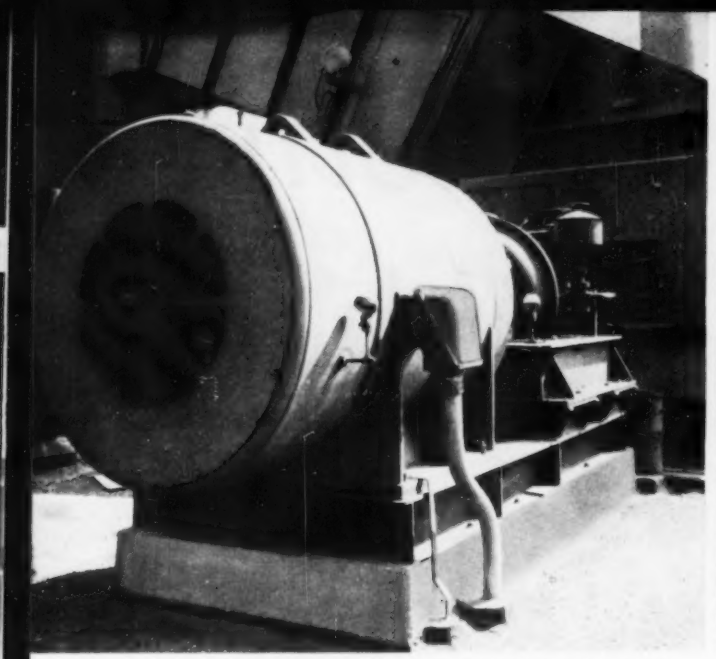
Proved Motor Dependability



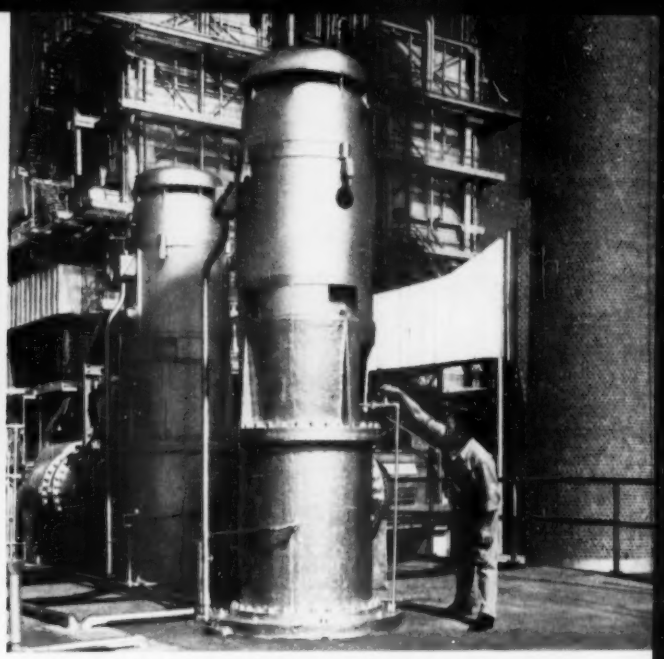
G-E TOTALLY ENCLOSED AIR-WATER COOLED MOTOR is an economical choice for 250 hp and larger. Simple to install, it needs no ducts, filters or blowers. Total enclosure means less maintenance by keeping out dust and other foreign particles. Shown here driving blower in a Kansas plant.



LARGE G-E OPEN DRIPPROOF MOTORS, four or more poles, such as this one coupled to circulating water pump in Cliffside Steam Station of Duke Power Company, are designed for indoor applications only. They are widely used on hot well pumps, forced- and induced-draft fans, and coal pulverizers.

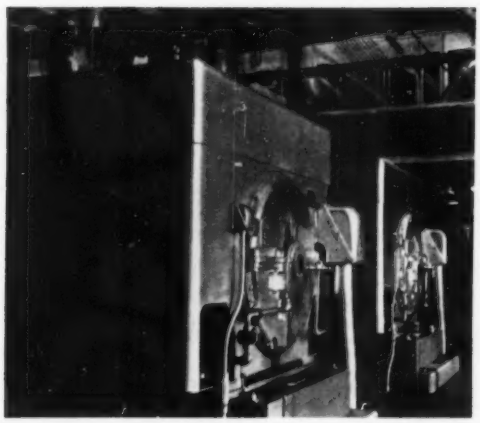


THIS G-E TOTALLY ENCLOSED FAN-COOLED MOTOR drives an induced-draft fan in the Edwardsport Steam-electric Power Station of Public Service Company of Indiana. Total enclosure assures the ultimate in motor protection required for operation in severe atmospheric conditions.



G-E VERTICAL TOTALLY ENCLOSED FAN-COOLED MOTORS, with Tri-Clad* construction, such as these driving pumps at New Orleans Public Service Inc., A. B. Paterson Steam-electric Generating Station, are used for dependable, low-maintenance service in severe ambient conditions.

for Power Station Service



TWO G-E WEATHER PROTECTED MOTORS, grade mounted, driving boiler feed pumps at Florida Power & Light Company's Cutler Plant. Available also in vertical and base ventilated design, this low-cost motor is designed especially for outdoor service where the extra protection of totally enclosed fan-cooled design is not economically justified. Bulletin GEA-5810.

*Reg. Trade-mark of General Electric Co.

G.E.'s complete line of power station auxiliary motors—field proved—assures you of getting the right motor for every operating requirement and station design.

Power stations across the country have installed dependable G-E motors for every auxiliary use. Because of the extensive field study that General Electric has devoted to power station requirements and the engineering experience gained through building all types of power station equipment for over 70 years, you are always assured of getting the right motor for economical and dependable service.

Whatever your needs in power station motors, General Electric can furnish the right type and size from a complete line . . . a wide variety of designs, enclosures, and application variations. You get exactly the motor needed to meet conditions of your operating practice, economics or location.

For more information on G.E.'s complete line of power station auxiliary motors contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, N. Y.* 7346

GENERAL ELECTRIC

For more data circle 507 on Post Card

announcing

GULF OILCOAT T

Protects lubricating systems during shipment and storage
Will not contaminate turbine lubricating oils
Used by General Electric to protect turbines during shipment

the ideal turbine rust preventive

Now—an effective turbine rust preventive that is non-oil contaminating!

Gulf Oilcoat T—the latest development of Gulf Research Laboratories—in addition to protecting turbine lubricating systems from rust during shipment and storage, will not contaminate turbine lubricating oils. This compatibility with lubricating oils is of paramount importance if your turbine system is flushed with the same oil that is to be used for lubrication.

General Electric Company, after comprehensive testing, has established Gulf Oilcoat T as an effective rust preventive and is using it in G-E turbines.

Because of its light viscosity this new product may be sprayed on metal surfaces, or it may be applied by dipping or brushing.

Although developed primarily for protecting turbine lubricating systems, Gulf Oilcoat T also prevents corrosion on other types of machinery during extended shutdowns.

GULF SERVES INDUSTRY

Gulf Oil Corporation
Gulf Refining Company
1822 Gulf Building
Pittsburgh 30, Pa.

support Junior Achievement

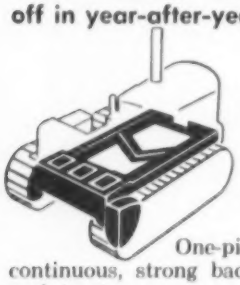
For more data circle 530 on Post Card

You can measure this tractor's value by tons of coal handled . . .

Allis-Chalmers HD-9

Weight — 18,800 lb.
72 drawbar hp.
Six speeds forward to 5.7 mph.
Three speeds reverse to 4.4 mph.

The Allis-Chalmers HD-9 Tractor offers performance reliability and ease of servicing that pays off in year-after-year efficiency on coal handling. Here's what we mean:



Built to stand the gaff of daily use for years . . .

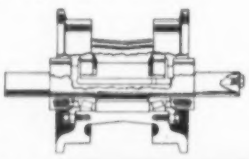
One-piece, welded main frame forms a continuous, strong backbone that means longer life for each tractor.

Oil-enclosed track release mechanism keeps adjustment at required setting and reduces track maintenance and breakage.

Smooth-shifting power train gives extra life, greater ability to absorb the punishment of tough jobs for every gear, shaft and bearing.

A-type truck frames permit free track oscillation and eliminate twists and strains caused by rough terrain.

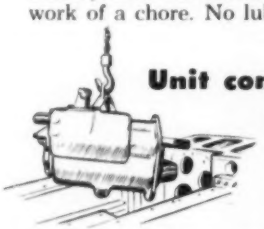
Easier lubrication saves time, helps protect equipment



Lubrication for 1,000 hours for final drives, truck wheels, idlers and support rollers saves both grease and time.

Spring-loaded, positive seals keep grease in, keep dust and water out.

Fewer, more accessible lubrication points make short work of a chore. No lube points at all under tractor.



Unit construction puts tractors back to work sooner

Transmission can be removed as a unit without removing clutch, final drive or bevel gear.

Engine can be removed without disassembling clutch.

Truck frame can be dismantled without removing final drive, sprocket or equalizer spring.

Clutch assembly can be removed without disturbing engine or transmission.

Final drive gear and intermediate gear can be removed without disturbing steering clutch.

Each steering clutch can be removed independently without disturbing final drive or bevel gear.

• • •

Let your distributor tell you more about the rugged construction, ease of servicing and outstanding performance ability of the Allis-Chalmers HD-9 Tractor. It's a story that adds up to coal handling dependability *you can measure by the ton.*

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

NO GETTING AROUND IT!

De Laval Oil Purifiers Give Double Protection

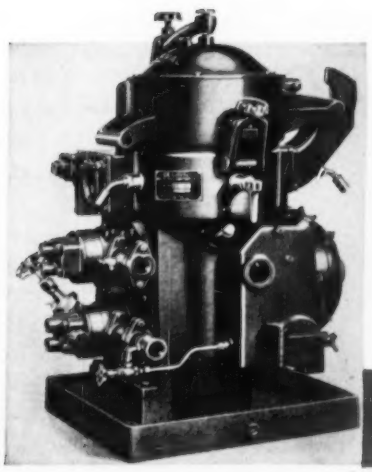
There's no avoiding the fact that a turbine requires protection from ***two*** troublemakers—dirt and water. Any device that removes only the dirt does only half a job.

That is why De Laval Oil Purifiers are so much more effective for maintaining the purity of turbine oil than any other means available. They not only remove solid contaminants but also any moisture that may be present.

It is important to get such ***double protection,*** for oftentimes water, rather than dirt, is the real source of contamination. For example, condensate in oil leads directly to the formation of sludge, and, of course, if a water leak should ever develop, serious emulsification and real trouble might occur.

De Laval Oil Purifiers do not remove oil-soluble additives. The purifying action is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

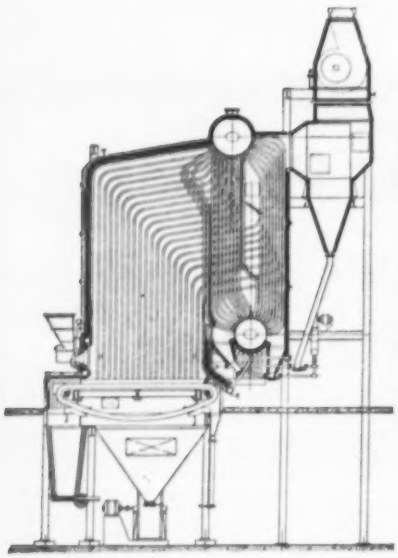


DE LAVAL

for more dependable power production

LUBRICATING OIL PURIFIERS

For more data circle 512 on Post Card



MUNITIONS

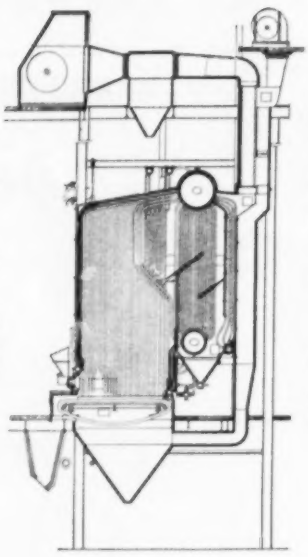
No. Boilers . . (2)

Capacity each
50,000 lbs./hr.

Design Pressure
160 psig

T. T. Steam 366 F

Firing
Erie City "Travagrate"



AUTOMOTIVE

No. Boilers . . (2)

Capacity each
100,000 lbs./hr.

Design Pressure
700 psig

T. T. Steam 750 F

Firing
Erie City "Travagrate"

ERIE CITY'S 2-DRUM STEAM GENERATORS

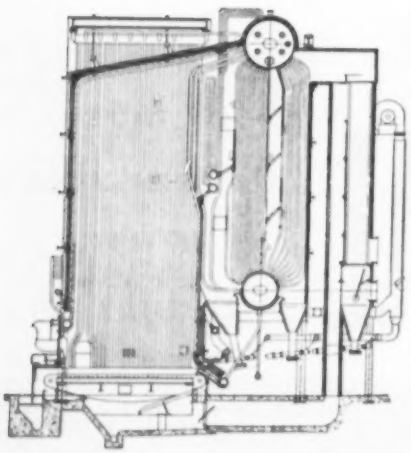
Erie City . . . pioneer in the development of the 2-drum boiler and the application of water walls to furnace design . . . offers a complete, modern line of two, three, or four drum steam generators to solve your most complex problem.

Installations such as shown here indicate the versatility of the Erie City 2-Drum steam generator. The wide range of sizes, adapted to all types of mechanical firing prove its adaptability to all classes of industry. The broad experience of Erie City qualifies it to combine proper boiler selection with efficient use of modern heat recovery equipment and proper application of firing equipment. Add to this the fact that Erie City steam generators are designed to include the best of modern utility standards and then you know . . . "YOU CAN DEPEND ON ERIE CITY FOR SOUND ENGINEERING" . . . is not just a statement. It is a positive fact that can prove to be of value and profit to you.

ERIE CITY
114 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



SUGAR

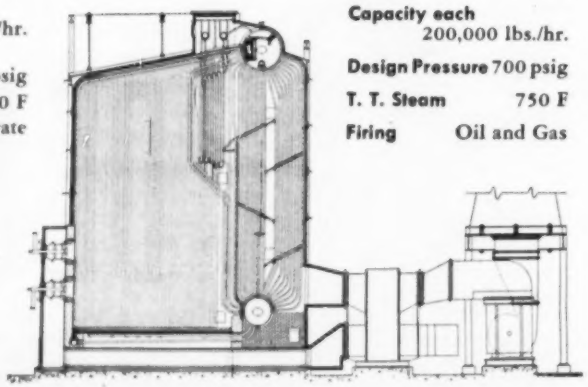
No. of Boilers . (2)

Capacity each
150,000 lbs./hr.

Design Pressure
450 psig

T. T. Steam 570 F

Firing Traveling Grate



CHEMICAL

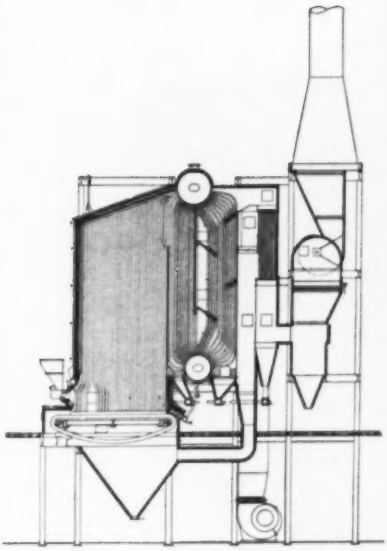
No. of Boilers . . (3)

Capacity each
200,000 lbs./hr.

Design Pressure 700 psig

T. T. Steam 750 F

Firing Oil and Gas



U. S. GOVERNMENT

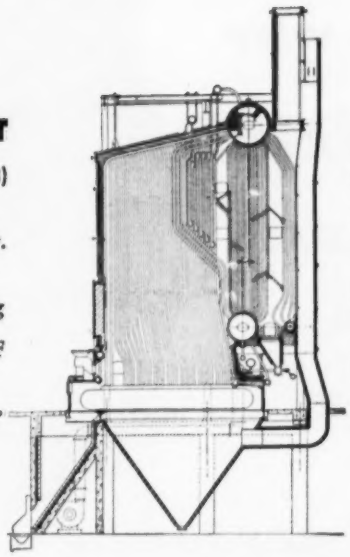
No. of Boilers . (3)

Capacity each
105,000 lbs./hr.

Design Pressure
200 psig

T. T. Steam 371 F

Firing
Erie City "Travagrate"



AVIATION

No. of Boilers . (8)

Capacity each
135,000 lbs./hr.

Design Pressure
475 psig

T. T. Steam 715 F

Firing Chain Grate

SATISFY BROAD DEMANDS

All Erie City 2-drum steam generators are equipped with contact type steam scrubbers. These scrubbers utilize reverse flow and contact with bare corrugated metal surfaces to insure moisture free steam at outlet.

PETROLEUM

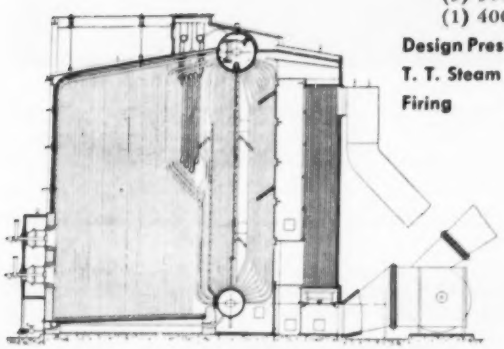
No. of Boilers . . (4)

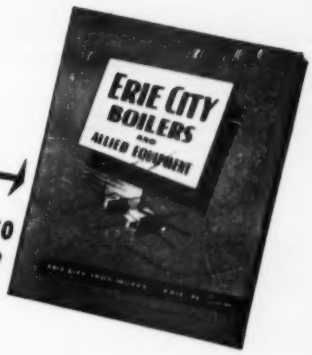
Capacity each
(3) 300,000 lbs./hr.
(1) 400,000 lbs./hr.

Design Pressure 725 psig

T. T. Steam 688 F

Firing Oil and Gas

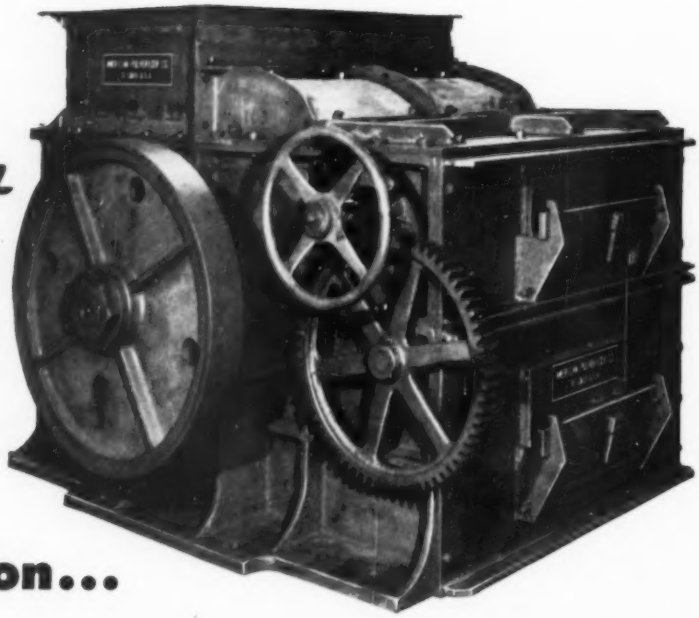


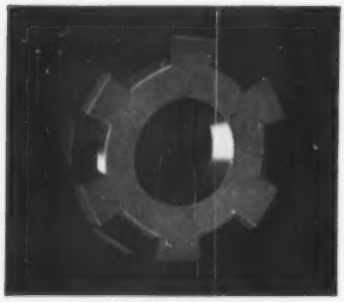


***GENERAL CATALOG SB-50** describes the complete line of Erie City Boilers and Allied Equipment.*

For more data circle 513 on Post Card

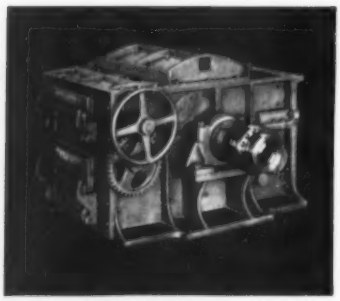
5 reasons why *American Crushers* can reduce coal for less than [pie chart] per ton...





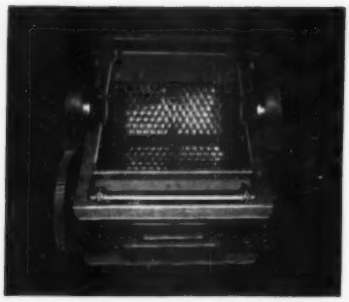
1 Patented Shredder Ring

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



2 Heavy-Ribbed Steel Frame

Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.

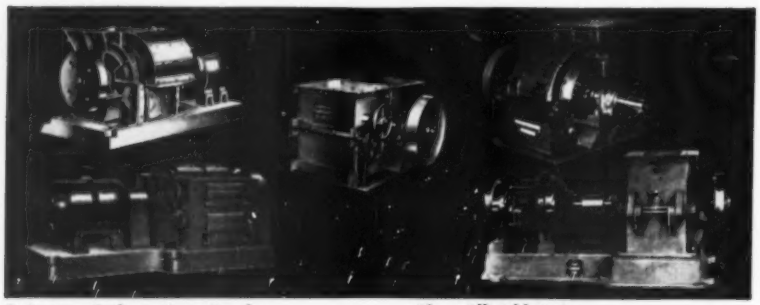


3 Completely Lined Crushing Chamber

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.

4 Complete Accessibility to Adjustment and Parts

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.



5 Custom-Built to Your Needs

American has developed many crusher types, each in a number of sizes. Custom-designed with the proper crushing elements, grate bars or screen plates to produce the desired product in the quantities required.

They All Add Up!

Whenever you figure cost per ton, the best answers come from American. By actual survey, American Crushers, in use an average of ten years, show a parts replacement cost of only 1/10th of 1¢ per ton of coal crushed!

American **PULVERIZER COMPANY**

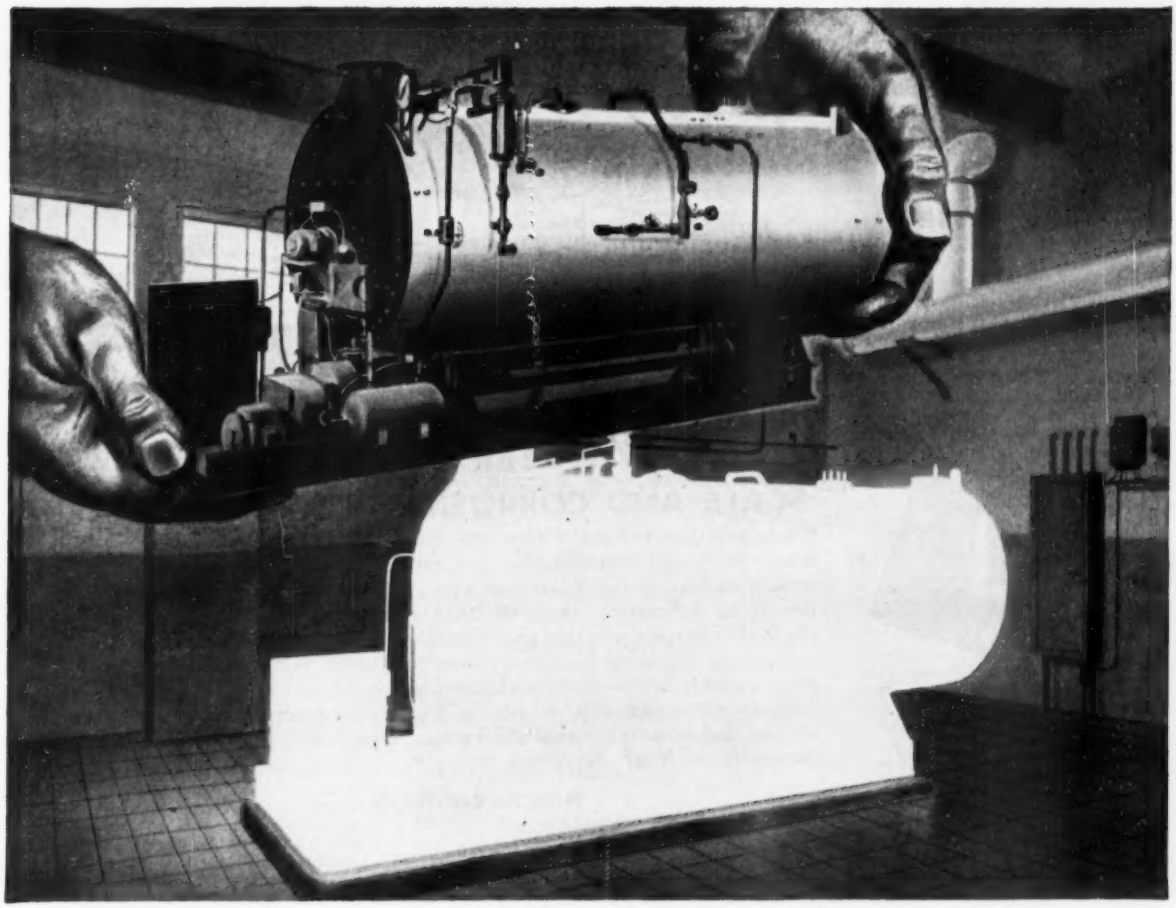
Coal Crushers up to 800 Tons Per Hour • Laboratory Crushers up to 2,000 Lbs. Per Hour

Originators and Manufacturers of Ring Crushers and Pulverizers

1431 MACKLIND AVENUE

For more data circle 514 on Post Card

Here's why you get more...when you buy a Cleaver-Brooks Self-Contained Boiler



...only Cleaver-Brooks can offer you the experience gained from more than 20 years of pioneering . . . and more than 12,000 individual "packaged" boiler installations

CLEAVER-BROOKS pioneering has been largely responsible for simplifying boiler buying . . . lowering costs of installation . . . delivering 80% guaranteed steam efficiency from every fuel dollar when firing with oil.

Boilers can be shipped as completely assembled and tested self-contained units, with auxiliaries as required. Installation involves minimum of time, construction and space. Usually connections only to steam, fuel, water lines and electrical service are needed. No special foundations are required. A short vent takes care of exhaust gases. Frequently, boilers are ready for use in a matter of *hours*, depending on availability of service lines.

Cleaver-Brooks, originators of the self-contained boiler, offers wider experience that counts in another important way. Qualified engineers help you plan steam plants tailored *exactly* for your needs. Carefully analyzed are loads, space and equipment arrangement. This not only helps you solve present steam needs, but adds flexibility for future expansion as well.

This application engineering, plus basically sound design and construction is your assurance of a full return from your boiler investment. When you specify a self-contained boiler — make sure it's a Cleaver-Brooks.

Send for Catalog AD-100 for full details on Cleaver-Brooks boilers. Available for oil, gas and combination oil/gas firing. Sizes 15 to 500 hp, 15 to 250 psi — for heating and processing.

CLEAVER-BROOKS COMPANY
Dept. B, 310 E. Keefe Ave.
Milwaukee 12, Wisconsin, U.S.A.

Cleaver-Brooks

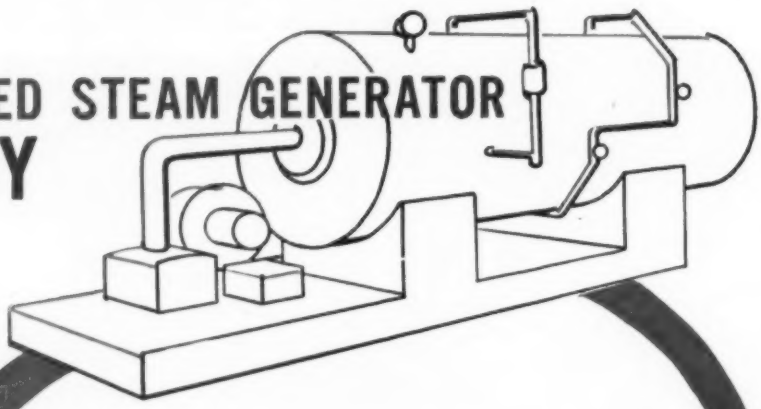
ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment Oil and Gas Fired Conversion Burners

For more data circle 515 on Post Card

Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT

SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE

FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM • Serving Industry through Practical Applied Science

For more data circle 540 on Post Card

HELPFUL BULLETINS

These new and revised publications offer help on many of your operating and maintenance problems. To order, use the Reader Service Cards on page 129.

INSTRUMENTS AND CONTROLS

101 Instrumentation at Work — Newest edition of this company's magazine, Instrumentation, is now available to power engineers. Included in this 48-pp issue are articles covering increased production in a textile mill, treatment of 40 million gal of water a day, test room control, recovery of hydrocarbons and others. Industrial Div., Minneapolis-Honeywell Regulator Co.

102 Switchboard Instruments — Bulletin GEC-218C, 24 pp, describes company's long-scale instrument lines. Gives principles of operation, characteristics and specifications. Prices and dimensions are provided. General Electric Co.

103 Chart Recorder-Controller — Technical Data Bulletin F-452M describes a multi-point circular chart recorder, and its component parts — the "Turret" pen assembly which makes possible six individual records on a single circular chart, and the "Segmental" chart drive unit, through which the instrument becomes either a 24-, 48-, or 96-pt-multi-record system. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

104 Temperature Control Systems — Bulletin F-6149, 8 pp, on industrial process temperature control, aids in selection of sensing elements and their correct use. Explains and discusses the various types of systems, from two-position "on-off" to proportional position with automatic reset. Wheelco Instruments Div., Barber-Colman Co.

105 Specialized Instruments — Company's specialized instruments and gages are described and illustrated in this bulletin. Includes equipment for measuring combustion, draft, pressure, flow, vacuum, temperature. F. W. Dwyer Mfg. Co.

106 Flow Signal Transmitter — Bulletin 2553, 8 pp, describes company's heavy-duty pneumatic signal transmitter for measuring, indicating and controlling fluid flow and liquid level at operating pressures up to 1500 psi and pressure differentials up to 100 psi for steam generation and process control. Features design details which give transmitter a linear-flow characteristic without need of additional square root extractors in totaling equipment, other features. Hagan Corp.

107 Optical Pyrometer — Eight-pp Catalog 85 discusses principles of optical pyrometry and features of company's pyrometer, operating procedures and applications. Lists accessories and gives pertinent technical data. The Pyrometer Instrument Co., Inc.

108 Combustion Control — Bulletin SA 11-50 discusses robot-eye combustion control for rotary cup oil burners, for use in manual, semi-automatic or fully-automatic systems. Lists component parts of equipment. Standard Instrument Corp.

109 Control System — Four-pp Bulletin A-707-A describes company's Type D2T Autronic differential pressure transmitter and gives data on principles of operation. Illustrations include hook-up and schematic diagrams, phantom-cutaway views and dimensional diagrams. The Swartwout Co.

110 Temperature Controller — Bulletin P-811, 10 pp, covers company's new 077 electronic temperature controller, with range extended to cover −100 to 600 F. Contains specifications, prices and application information in two models, also data on resistance thermometer elements and wells, and control motors. Minneapolis-Honeywell Regulator Co.

111 Force-Balance Positioner — Bulletin 473 describes the Poweractor, force-balance type positioner for cylinder-operated devices. Tells how this unit, designed for use with company's Stabiload cylinder, will position equipment requiring high power and long stroke, such as large size control valves and variable speed drives, through pneumatic cylinder (or springless diaphragm) operating mechanisms. Complete specifications are provided. Foxboro Co.

112 Air-Flow Control — Application and installation ideas, suggested circuits for use of Detect-A-Flo, a device which controls or detects liquid level and air flow, are presented in this 16-pp illustrated bulletin. Discusses principle of operation, specifications, response curves on performance, operation and electrical characteristics. Fenwal Inc.

113 Electronics Equipment — Sixteen-pp Bulletin B-6093 describes application and operating range for surge comparison testers, portable balancers and vibrographs and magnetic amplifiers. Gives information on transformer cores and on magnetic materials and alloys. Westinghouse Electric Corp.

MECHANICAL POWER TRANSMISSION

114 Power Transmission Equipment — Flexible couplings, variable speed pulleys and transmissions, and universal joints are presented in this illustrated 8-pp bulletin. Specifications, dimensions and design information are provided, also references to detailed literature covering each class of equipment. Lovejoy Flexible Coupling Co.

115 Variable Speed Drives — Folder 2374 gives detailed information on company's Size 6 P.I.V. (positive, infinitely variable) speed drives, in three types for 20 to 25 hp application. Gives data on basic drive and gear arrangements. Link-Belt Co.

116 Gearmotors — Bulletin B-5645, 16 pp, describes company's Life-Line gearmotors. Discusses features of gear unit and motor, giving gear ratios for single, double and triple reduction types. Describes other types developed for particular requirements. Westinghouse Electric Corp.

117 Controls for Drives — Bulletin G-537, 24 pp, describes controls available on company's variable speed drives. Tells how to solve problems in control of tension, acceleration and deceleration, velocity and peripheral speed, synchronization of one or more machines, and maintenance of uniform temperature, pressure, liquid level, flow. Reeves Pulley Co.

118 Transmission Belting — This 34-pp catalog on rubber transmission belting describes and illustrates construction features of various industrial belts with sections devoted to oilproof, textile, lumbermill and agricultural belts. Describes method of making the Plylock belt joint, which is claimed to eliminate the cause of nearly all belt failures. The B. F. Goodrich Co.

PIPING AND VALVES

119 Pipe Data — Technical Data Card 138 A contains information on dimensions, weights, specifications, grades and analyses of seamless and welded carbon, alloy and stainless steel pipe. Gives pertinent data on six pipe size schedules and reference data to steels covered by ASTM and ASME piping specifications. Tubular Products Div., The Babcock & Wilcox Co.

120 Data for Pipe, Fittings — This 28-pp booklet provides engineering data tables for use with manufacturer's corrosion resistant pipe, tubing and welding fittings. Besides giving facts and formulas, it answers most frequent questions of pipe and tube users. Tables cover corrosion resistance of nickel alloys, chemical and physical properties of alloys, pipe flow data, fluid-flow-friction losses, beam formulas, ASTM specifications, bolt strength. Stainless Welded Products, Inc.

121 Needle Valves — Twelve-pp Section A presents application and engineering data on needle valves for liquid or vapor service, in types for controlling small volumes through pipe lines and for minute throttling of small flows. Illustrated; gives dimensions, capacities, materials of construction. Associated Valve & Engineering Co.

122 Pressure Switches, Valves — Catalog 36, 20 pp, describes and pictures company's "Shear-Seal" valves for manual control of vacuum or pressures up to 6000 psi, including four-way, dual pressure selector and shut-off models for pipe sizes up to 1½ in. Contains data on solenoid controlled valves, selector and shut-off for service up to 3000 psi. Air discharge table is included to help determine valve size. Barksdale Valves.

123 Air Valve — Eight-pp Engineering Bulletin 61861 describes a wobble-rod air valve for on-off control with pneumatic systems. Gives specifications, price data, illustrates application ideas on actuating mechanisms, hook-ups and multiple-valve arrangements. Contains sectional and engineering drawings. Pantex Mfg. Corp.

ELECTRICAL EQUIPMENT

124 Distribution Regulators — Twelve-pp Bulletin 21B7977 gives external and internal features of manufacturer's distribution regulator, Type JFR. Illustrates "Quick-Break" tap-changing mechanism, "Feather-Touch" control and unit

construction; gives examples of installations. Lists standard accessories and specifications for regulator in ratings of 2500 v, 100 and 200 amp; 5000 v, 50 and 100 amp; 7620 v, 15, 50 and 100 amp, and 14400 v, 50 and 100 amp. Allis-Chalmers Mfg. Co.

125 D-C Indicating Instruments — Eight-pp Bulletin GEC-979A describes portable d-c indicating instruments. Provides information on the applications, features, prices and performance of manufacturer's Type DP-11 and DP-12 instruments. General Electric Co.

126 To Make Good Connections — Tips on making good connections with aluminum conductors are given in this little 20-pp booklet. Humorous illustrations and brief text cover application of compound, wire brushing, use of pressure, use of spacers, problem of galvanic corrosion, sealing, use of armor tape, plating, application of inhibiting compound, and other important factors. Kaiser Aluminum & Chemical Sales, Inc.

127 Sealed Terminals — Six-pp Bulletin 949-A presents, in handy chart form, specifications and data on some 48 types of hermetically sealed terminals. Also included is general information on standard coding system for sealed terminals, on installation method, and on eyelets. Electrical Industries.

128 Switch Control Mechanisms — Manual mechanisms (both horizontally and vertically mounted switches), motor mechanisms, interlocks, hook sticks are listed in illustrated Bulletin 326, 8 pp. Includes application suggestions. Electrical Engineers Equipment Co.

129 For Cable Handling — The Reel-O-Matic, for handling cable and wire rope, is featured in this illustrated bulletin. Shows how its one-man operation saves time and labor and how its compact design saves storage space. Describes models with motor-operated and manually-operated platforms, also larger units for the big jobs and midget sized ones. Reel-O-Matic Corp. of America.

PUMPS, PUMPING

130 Controlled Volume Pumps — Sixteen-pp Bulletin 1053 shows how air-powered controlled volume pumps help solve low-capacity flow control problems. Illustrates pump operating principles; capacity-pressure and air-consumption tables. Gives examples of company's engineered chemical feed systems using these pumps in a multiple chemical feed system, constant feed system, others. Milton Roy Co.

131 Centrifugal Pumps — Three types of company's Uni-Built centrifugal pumps with mechanical seal are described and illustrated in 14-pp Bulletin ET-452. Features materials of construction, selection tables, dimensions in inches, and information on installation and operation. Includes parts list. Bell & Gossett Co.

132 Chemical Feed Pumps — Twelve-pp Technical Paper 57 discusses design and operation of controlled volume chemical feed pumps from basic units to specialized models. Complete systems are illustrated to show application of these pumps in pH control, automatic titration and proportional feeding. Discusses new designs and developments, including the Constametric, a reciprocating plunger, positive displacement type pump for pulsation-free flow. Milton Roy Co.

. . . Outstanding Among This Month's Catalogs

133 Easier Power Plant Cleaning — This 42-pp pocket-size handbook, "How to Make Power Plant Cleaning Easier," gives methods and solution concentrations and temperatures used in all types of power plants for the tough cleaning jobs. Covers the cleaning and descaling of surface condensers and heat exchangers; cleaning of compressors, steam turbines, filters, boilers, gas burners and electric motors; the removal of carbonized oil from copper cooling coils, and varnish from steel plates. Also discusses methods of stripping paints from various surfaces. Includes sections on steam detergent cleaning and on maintenance cleaning of floors, painted equipment. Book is fully illustrated and indexed for easy reference. Oakite Products, Inc.

134 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers; condenser-tower with tables showing parts, dimensions and ratings in tons refrigeration. Henry Vogt Machine Co.

135 Fan Engineering Data — Bulletin A-108, 16 pp, gives fan laws and formulas, terms and definitions, and recommended velocities for exhaust hoods. Includes air pressure conversion table, charts on dust resistance, entrance losses and rectangular equivalents of round ducts. Discusses fan installation, maintenance and lubrication, noise problems, and characteristics of propeller and wheel designs. Hartzell Propeller Fan Co.

136 Manual on Packings — Generously illustrated with photos and mechanical drawings, this 60-pp catalog is divided into three sections, the first of which covers development, standardization and types of hydraulic and pneumatic packings. Application data for cup, flange, U and V packings is provided. Importance of leather as a packings material is discussed in the second section, along with information on water-well cups, valve and special leathers. The third section is devoted to natural and synthetic rubber packings, and their properties and characteristics are evaluated. Full dimensional data and information on special packings and oil seals are included in this book. Graton & Knight Co.

PROTECTIVE COATINGS

137 Guide to Rust Prevention — The 24-pp 1954 edition of this company's general catalog provides a treatise on rust prevention. Features 94 color chips of manufacturer's products and includes instructions for surface preparation and application of primers, short- and long-oil types, machinery and implement finishes, chemical and heat resistant types, sealers, oil field finishes, thinning oils and floor and masonry coatings. Presents a restful color group of finishes for plant interiors. Application photos show how each product is used and text answers questions on common rust prevention problems. Rust-Oleum Corp.

138 Protective Coatings — This 12-pp booklet describes Micro-Seal coatings, asphaltic compounds of a special chemical dispersion type. Non-flammability, freedom from odor, flexibility, easy application, low maintenance and other advantages are detailed and typical applications pictured. Specifications of these corrosion proofing coatings are included, also directions for use. Anderson-Prichard Oil Corp.

139 Protection Against Rust — This bulletin describes and gives application data for Z.R.C., a coating applied to iron and steel to provide a dried film protective coating of 93 to 95 per cent pure zinc. Details surface preparation, coverage, finish. The Sealube Co.

140 Coal Tar Protection — This 8-pp booklet describes Tapecoat, a close-woven fabric saturated in coal tar so coating is on both sides and serves as both protection and bond. Fully illustrated, discusses use of this type of protection on pipe lines, conduit, tanks, and couplings. The Tapecoat Co.

LIGHTING, COMMUNICATION

141 Tower Lighting — Technical Data Bulletin 381-F, 20 pp, shows diagrammatically how to meet FCC requirements for lighting microwave and other relay towers. Lists kits of lighting equipment and controls together with complementary equipment required for the various heights of towers. Crouse-Hinds Co.

142 Mobile Communication Equipment — Two new bulletins are available on the Carfone, a transmitter-receiver for two-way communication in the 152–174 mc band designed for installation in a vehicle. Catalog C.30 gives features and specifications for the 15-w Carfone, and Catalog C.3011 gives similar data on a 30-w model. RCA Victor Div., Radio Corp. of America.

BOILER, BURNER EQUIPMENT

143 Oil and Gas Burners —Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

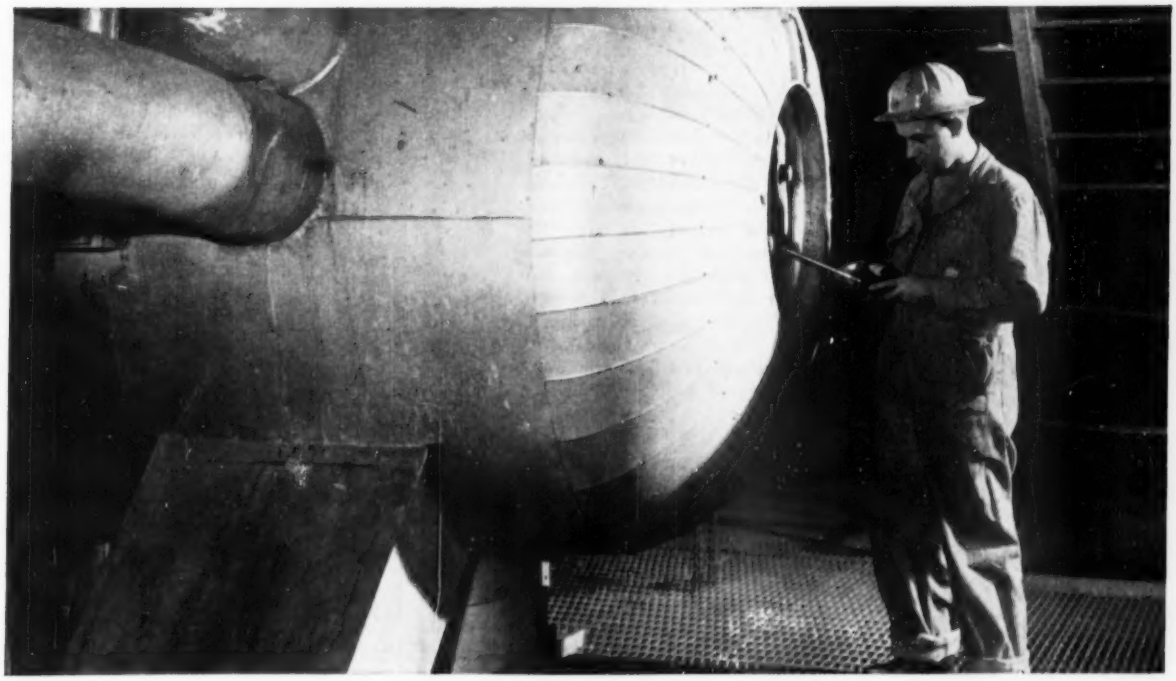
144 Boiler Water Sample Cooler — Bulletin 110 gives specifications of company's boiler water sample cooler No. 75, and charts to determine cooling water flow rate for various sample temperatures. Includes typical piping hookups, installation and operation instructions as well as standard specifications. Davis Engineering Corp.

145 Improved Boiler Base — Form 62, 6 pp, describes and pictures the Inspecto Base for waterleg type boilers. Shows how this steel base affords waterleg visibility boiler leveling, rapid job-site assembly, other advantages. Includes specifications. Plibrico Co.

more bulletins on page 26

CHEMICAL CLEANING PROVED MORE EFFECTIVE IN BOILER TEST

DOWELL method showed greater efficiency by 4.5% in utility company comparison



Perhaps the most convincing way of demonstrating the advantages of one method of cleaning over another is to conduct a comparative test.

That's exactly what one of the larger utility companies did to compare chemical cleaning with mechanical cleaning. The 23-day test was conducted with companion boilers, rated at 200,000 lb. per hour operating at 500 p.s.i. One boiler was chemically cleaned by Dowell in 12 hours, the other was turbined in one week.

At the conclusion of the test, the boiler which was chemically cleaned by Dowell had a 4.5% greater efficiency factor. It also used 10% less coal per KWH gross produced than the other boiler. With results like this to cite, it's no wonder leading plants in all parts of the country rely on Dowell service for their maintenance cleaning.

Dowell engineers do the job for you, using liquid solvents which are brought to your plant in truck-mounted tanks along with all necessary pumps and control equipment. No special scaffolding is required. Dismantling and down-time are kept to a minimum; equipment can often be cleaned while in operation.

For complete information and estimates on cleaning your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. B-14.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

For more data circle 517 on Post Card

how to SOLVE your LOW-CAPACITY FLOW CONTROL problems

This new 16-page Bulletin 1053 on Air-Powered Controlled Volume Pumps is your guide to precise flow rate control of low-capacity chemical and slurry streams. It contains a graphic presentation of pump operating principles; capacity-pressure and air-consumption tables; examples of complete Milton Roy engineered chemical feed systems, using these instruments. Solve *your* low-capacity flow control problems. Send for your copy of Bulletin 1053, *now*.

Q. What are Controlled Volume Pumps?

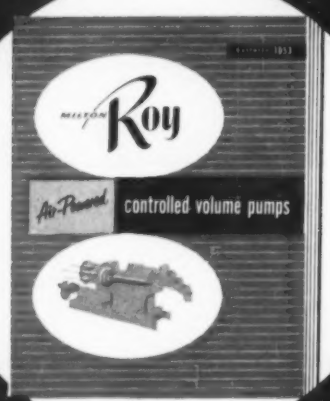
A. Reciprocating, positive displacement, flow control instruments, driven by air or electric motor. They pump with a repetitive accuracy of plus or minus one percent. Capacities from 3 milliliters per hour to 45 gallons per minute... Pressures to 25,000 pounds per square inch. Capacity adjustment—manual... or automatic response to a control signal from an electronic or pneumatic control instrument.

Q. Where are Controlled Volume Pumps Used?

A. Across all industry... for flow control and pumping of precise quantities of chemicals and slurries... for accurate ratioing of chemical streams... and for automatic control of a process variable, such as pH, using these pumps as final control elements.

Q. What is the Milton Roy Exclusive Step-Valve Liquid End?

A. A patented step-valve liquid end with individually inspectable ball checks (to facilitate cleaning). Sloping passages purge entrained air, assuring high repetitive volumetric efficiency.



Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

CONTROLLED VOLUME PUMPS ARE FLOW CONTROL INSTRUMENTS

Milton Roy COMPANY Manufacturing Engineers

1320 E. MERMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

For more data circle 518 on Post Card

HELPFUL BULLETINS

continued from page 24

146 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

WELDING

147 For Arc Welding — Twelve-pp bulletin, Twecolog 9, covers manufacturer's line of electrode holders, ground clamps, cable connectors and cable accessories for arc welding. Gives specifications, consumer quantity prices, general ordering information. Tweco Products Co.

148 Stranded Electrodes — Twelve-pp bulletin, "Stranded Electrode Materials for Aircomatic Welding," explains use of these wires in the inert-gas-shielded metal-arc consumable electrode Aircomatic welding process. Gives welding characteristics of a stranded electrode; photos show how wires are interwoven. Air Reduction Sales Co.

149 Valve Welding — Bulletin 507 lists socket welding end dimensions for valves 2 in. and smaller, and butt welding end, for pipes 2½ to 16 in., as approved by the American Welding Society. Diagrams show standard preparation of valve butt welding ends. Edward Valves, Inc.

WATER CONDITIONING

150 Water Filters — Ten-pp Catalog 300 shows the varied uses for company's synclinal filters for water application, available for sump or line installation in eight unit sizes from 5 to 100 gpm. Gives dimensional chart and engineering data for both types installations, also theoretical flow and pressure drop table. Marvel Engineering Co.

It's easy to get these free catalogs — just circle item numbers of those wanted on the two post cards provided on pages 129-130

151 To Prevent Boiler Scale — A method for removal and prevention of scale in boilers, water heaters and entire heating system is described in an 8-pp

Some men search for years among fine tobaccos before they find a blend that's just right. When they do find it, pleasure proves . . .

THERE'S ENOUGH DIFFERENCE

TO MAKE *ALL* THE DIFFERENCE

It's the same way with many products you buy for service, notably Heat Exchanger Tubes. Specifications for alloys and applications are well recognized. And yet it is true that many Scovill customers find enough difference in the performance of our Heat Exchanger Tubes to make *all* the difference in the efficiency and economy of their installations.

Part of it is due to Scovill production differences, such as Continuous Casting, and our century and a half of metal-producing "know-how." Part of it is due to Scovill's unrivaled Technical Application Services. Almost always it adds up to longer tube service, less trouble maintaining efficiency under tough operating conditions, worthwhile savings. Let us prove it. Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Conn. Phone Waterbury 4-1171.

SCOVILL

HEAT EXCHANGER TUBE

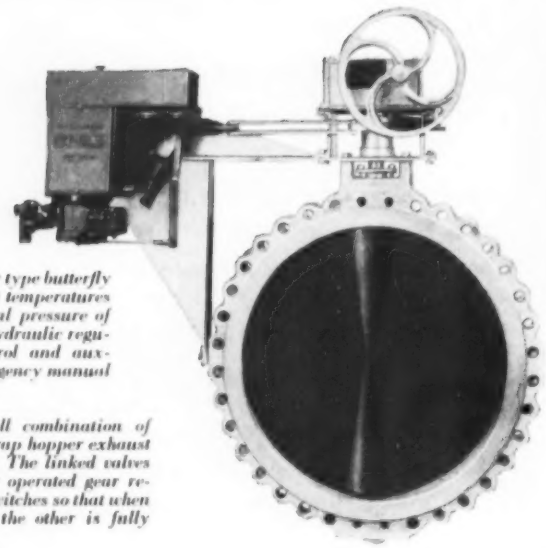
Phosphorized Admiralty ★ Admiralty ★ Arsenical Admiralty ★ Muntz Metal ★ Naval Brass ★ Red Brass, 85% ★ Deoxidized Copper ★ Arsenical Copper Copper Nickel, 10% & 20% ★ Cupro Nickel, 30% ★ Cupro Nickel, 30% (High Iron) ★ Aluminum Brass ★ Aluminum Bronze, 5% ★ Duplex Tube

25C54

For more data circle 519 on Post Card

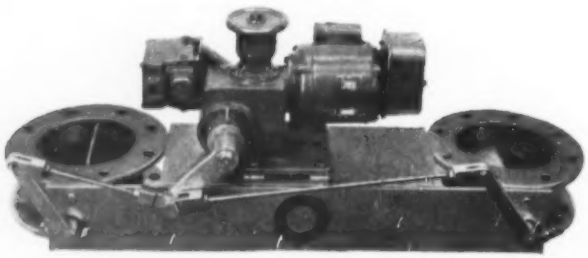
PERFORMANCE *plus*

AUTOMATIC-MANUAL
VERSATILE
Control and Shut-Off



W. S. Rockwell 42" wafer type butterfly valve for exhaust gases at temperatures to 320° F. and differential pressure of 25 p.s.i. Equipped with hydraulic regulator for automatic control and auxiliary handwheel for emergency manual operation.

Below — *W. S. Rockwell combination of two butterfly valves for a trap hopper exhaust system in a power plant. The linked valves are controlled by a motor operated gear reducer unit through limit switches so that when one valve is fully open, the other is fully closed.*



For minimum pressure drop, uniform quick control and positive shut-off — commercial, drip or air tight — W. S. Rockwell Valves are your answer. Sizes to 108"; pressures to 300 p.s.i., and higher, temperatures to 2000° F. Made of any metal or rubber lined. Write for Valve Catalog.

W. S. ROCKWELL VALVES

W. S. ROCKWELL COMPANY

2924 ELIOT ST. • FAIRFIELD, CONN.

For more data circle 520 on Post Card

bulletin, "Boiler Scale Is Costing You Money!" Tells how method cuts operating and maintenance costs. Evis Mfg. Co.

152 Ion Exchange — Sixteen-pp illustrated bulletin, "Amberlite Ion Exchange," relates ion exchange technology to familiar examples. Two-color drawings show fundamental processes. Lists 13 process types including water conditioning, removal of metal ion contaminants, recovery of metallic ions. Resinous Products Div., Rohm & Haas Co.

OTHER EQUIPMENT

153 For Liquid Cleaning — Illustrated 20-pp Bulletin 2204B describes applications, principles of operation and design features of company's precipitator, which manufacturers claim remove impurities efficiently from a liquid by precipitation, adsorption, settling and filtration. Includes floor diagrams and specifications. The Permutit Co.

154 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Also describes CMP units which combine in a single installation the advantages of the Multiclone cyclonic tube with the Cottrell electrostatic precipitator. Western Precipitation Corp.

155 Metal Hose — Catalog 130R, 32 pp, shows all types of Flexon metal hose, including company's Rex-Weld corrugated metal, Rex-Tube convoluted hose types, Rex-Flex stainless steel flexible metal hose, and special purpose assemblies. Features a new heavy duty stainless steel hose; gives coupling types and installation information. Flexonics Corp.

156 Aluminum Covering — A protective covering of lightweight corrugated aluminum for use over regular pipeline covering or insulating material is described in this illustrated folder. Protection offered, attractive appearance, permanency and efficiency of the material are stressed. Smith Products.

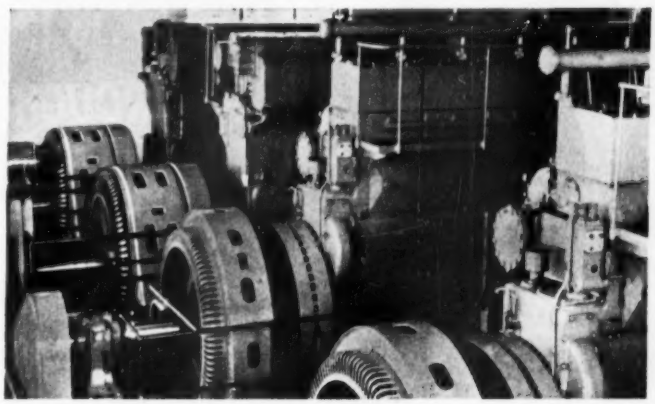
157 Blast Cleaning — Bulletin 1500, 30 pp, offers non-technical blast cleaning information such as: where it can be used; how abrasive is forcibly propelled; types of surfaces to be cleaned; finish required in a specified time; price per piece cleaned. Gives various types of blast cleaning machines with specific uses. Includes list of applications and glossary of terms used in book. Pangborn Corp.

158 For Lower Cost Insurance — How yearly insurance costs can be cut by use of company's Saveall Spray Sprinkler is shown in this 14-pp bulletin. Illustrates sprinkler with a fusible element of solid organic chemical and maintenance devices. Globe Automatic Sprinkler Co.

159 Protective-Atmosphere Furnaces — Twenty-pp Bulletin GER-811, "How to Cure Protective Atmosphere Troubles," discusses impurities causing furnace troubles, tests for oxidation and discoloration, furnace leaks. Tells how to take gas samples for analysis. Includes check sheet for troubles and cures in furnace operation. General Electric Co.

160 Plastic Materials — This 30-pp booklet gives information on materials of

"12,000 H.P. Hours per Gallon with Sinclair RUBILENE"



... says Leo D. Bradley, Manager
Western Michigan Electric Co-operative, Scottville, Michigan

"Our two Cooper Bessemer super-charged 1600 H.P. Model LS8T diesels deliver over 12,000 H.P. Hours per gallon of Sinclair RUBILENE H.D. Oil consumed," says Leo D. Bradley.

"We give much of the credit to the quality of this oil," continues Mr. Bradley. "RUBILENE® keeps our diesels exceptionally clean. Wear is kept at a minimum – the result is high efficiency ... low operating costs ... and low maintenance cost."

Sinclair Products have been used since the generating station first went into operation – 12 years ago. The recommendations made by a Sinclair Lubrication Engineer at that time plus continuous counseling service and superior Sinclair Products have meant substantial savings for this co-operative.

Perhaps a Sinclair Lubrication Engineer can help solve some of your lubrication problems. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

prolong engine life

For more data circle 521 on Post Card

ROTOJET®
Tube Cleaners

Clean tubes and pipes from ½" to 12" I.D. THOROUGHLY QUICKLY

ROTOJET Model 512 Air-driven Motor, universal joint, swing-frame head, and solid brush.

Our large stock of Rotojet air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines is available to meet most requirements without delay. Tube cleaner specialization for 43 years assures satisfactory results from any Rotojet equipment we recommend. Send for Bulletins J-410 and R-105. For quick action wire or phone, HUmboldt 3-0570.

ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Junior Model 532 Air-driven Motor, universal joint, cone cutter.

ROTOJET Junior Model C434 Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Ave. Newark 1, N. J.

For more data circle 522 on Post Card

construction for use in chlorine dioxide production and bleaching processes. Technical articles included in this booklet cover plastic materials, protective coatings, corrosion resistance of plastics, and plastic processing equipment. The Atlas Mineral Products Co.

161 Correction Chart for Rounds — This celluloid cylindrical correction chart is small enough to carry in your pocket. It indicates corrections to be added to hardness values obtained on cylindrical surfaces, when a comparison between the cylindrical hardness value and the hardness value of the same material tested flat is needed. Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc.

162 Low Temperature Insulations — This 20-pp booklet covers Fiberglas insulations for low temperature structures and equipment. Discusses design considerations, sets standards for vapor barriers, outlines application methods, and covers dry wall and hot dip constructions and self-supporting partitions. Products described include preformed insulation, asphalt-enclosed board, roof insulation, dual temperature pipe insulation, others. Book is well illustrated with photos, sketches and charts. Owens-Corning Fiberglas Corp.

Postage-free cards for ordering catalogs are on pages 129-130. You may also use the cards to ask for further information on the advertised products.

163 Preheating Combustion Air — How to reduce fuel consumption as much as 30 per cent by preheating combustion air for process equipment is told in this 12-pp bulletin. Discusses advantages of increased production, improved product quality, and reduced maintenance. Includes tables of operating data, photos and diagrams of typical installations and a chart for determining fuel savings. Air Preheater Corp.

164 Gas Unit Heaters — Twelve-pp Technical Bulletin 23-3 describes gas-fired unit heaters, including propeller fan and blower type heaters, ranging in capacity from 55,000 to 500,000 Btu per hour and burning all types of gas at the rated capacities. Includes capacity tables and roughing-in dimensions. United States Air Conditioning Corp.

165 On Unit Heater Maintenance — To assist power engineers responsible for steam and hot water unit heaters, this organization offers a timely folder on their care and maintenance. Pictures various types, gives installation essentials, maintenance procedure, and includes discussion of system corrosion. Industrial Unit Heater Assn.

166 Selecting a Heat Exchanger? — Now available is a handy heat exchanger calculator for use in the selection of this company's shell-and-tube type heat exchangers. Designed like a slide rule, it is used to determine square feet of surface necessary to transfer a given amount of heat between oil or water on the shell side and water on the tube side. It is applicable to standardized shell-and-tube single and multipass, fixed and removable tube bundle units. Young Radiator Co.

TRADE PAPER EDITION
Published by
SCHUTTE and KOERTING
Company

ENGINEERING

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • ROTAMETERS • FLOW INDICATORS • RADIAFIN TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

Why Should You Come To SK For Standard Or Special Heat Transfer Equipment?

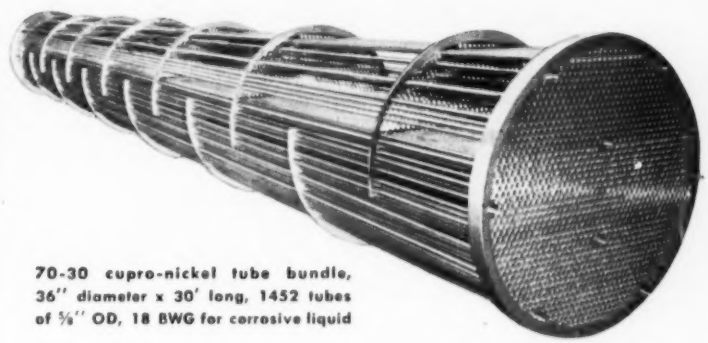
Have you, or are you likely to have, a problem in Heat Transfer involving *special* heavy duty equipment? Does your problem involve out-of-the-ordinary materials, highest precision and uniformity requirements, better than ordinary test and quality control facilities? Would you like to have technical assistance from HT specialists with wide experience?

Or do you just need a well designed, carefully built standard Heat Transfer Unit?

SK manufactures standard equipment, designs and builds special equipment for heat transfer service for pressures up to 5000 psi, temperatures to 1100° F.

And, *here's why* you should come to SK for such equipment—

All SK Heat Transfer Units feature: (1) close tolerances between tube OD and tube sheet hole ID; (2) polished tube ends to insure best metal to metal joint between tube OD and tube hole; (3) shell bores to exact tolerances to insure close fitting baffles for top efficiency; (4) rigid inspection of materials, methods, final assembly; (5) A.S.M.E. Code qualifications; and (6) electronically controlled tube expansion*. SK is particularly well equipped to solve unusual HT requirements, because . . .



70-30 cupro-nickel tube bundle, 36" diameter x 30' long, 1452 tubes of ⅝" OD, 18 BWG for corrosive liquid

SK has specialized in HT problem solving for a great many years—is set-up operationally for this.

The engineering staff is experienced—includes Chemical, Industrial, and Mechanical Engineers who *understand* chemical, power, processing, marine requirements, who *think* on the level you will require, who *talk* your language.

SK research facilities are set up to *anticipate* future requirements.

Production facilities are such that the company has been able to provide radiafin air coolers rated at 7500 hp weighing 47,000 lbs. . . . heat exchangers with special Everdur tube bundles, shells and head lining . . . 36" diameter, 30' long cupro-nickel units for cooling sodium carbonate solution for liquid rheostats . . . special units for handling hydrocarbon gases and synthetic rubber.

Quality Control and test facilities include equipment for hydrostatic, magnaflux, pneumatic, temperature shock, polariscope testing and radiographic inspection (250,000 Volt X-ray machine; Cobalt 60).

Space will not permit many other details worth noting but, if you want more information, do this: (1) write for Bulletin HT-1 which describes the type equipment we make, or (2) request a copy of Vol. 5 No. 3 Engineering News which contains an article on our problem-solving facilities.

*Tubes being expanded using electronically controlled tube rolling machine. This method provides advantages as follows: (1) every tube is expanded uniformly with no over or under expansion, (2) there is no enlargement of tube holes, (3) ligament fracture is prevented, (4) there is minimum tube elongation and tube sheet warpage is reduced, (5) tube wall stresses are reduced, (6) guess work is eliminated, ideal standards for tube joints apply.

SCHUTTE and KOERTING Company

34 STATE ROAD
CORNWELLS HEIGHTS
BUCKS COUNTY, PA.

Representatives in Principal Cities

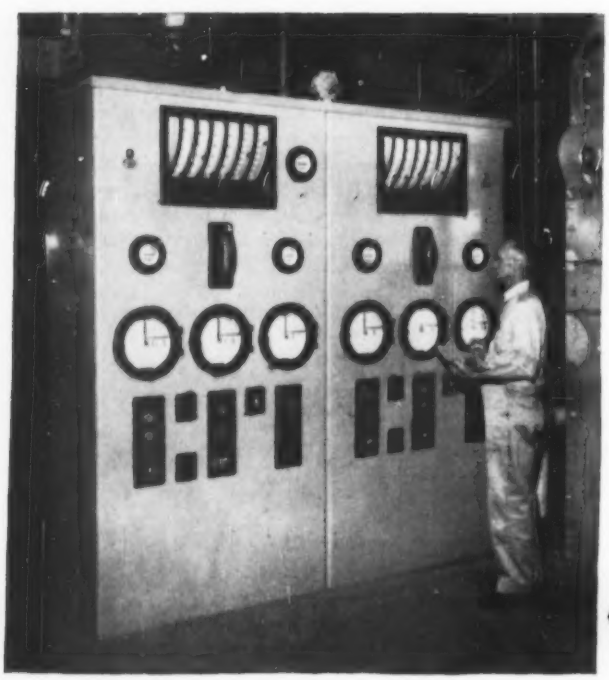
For more data circle 523 on Post Card

Boiler room at Kansas State College. Republic instrument panel is at left. Boilers are arranged for either gas or oil firing.

REPUBLIC *Automatic*

COMBUSTION CONTROLS

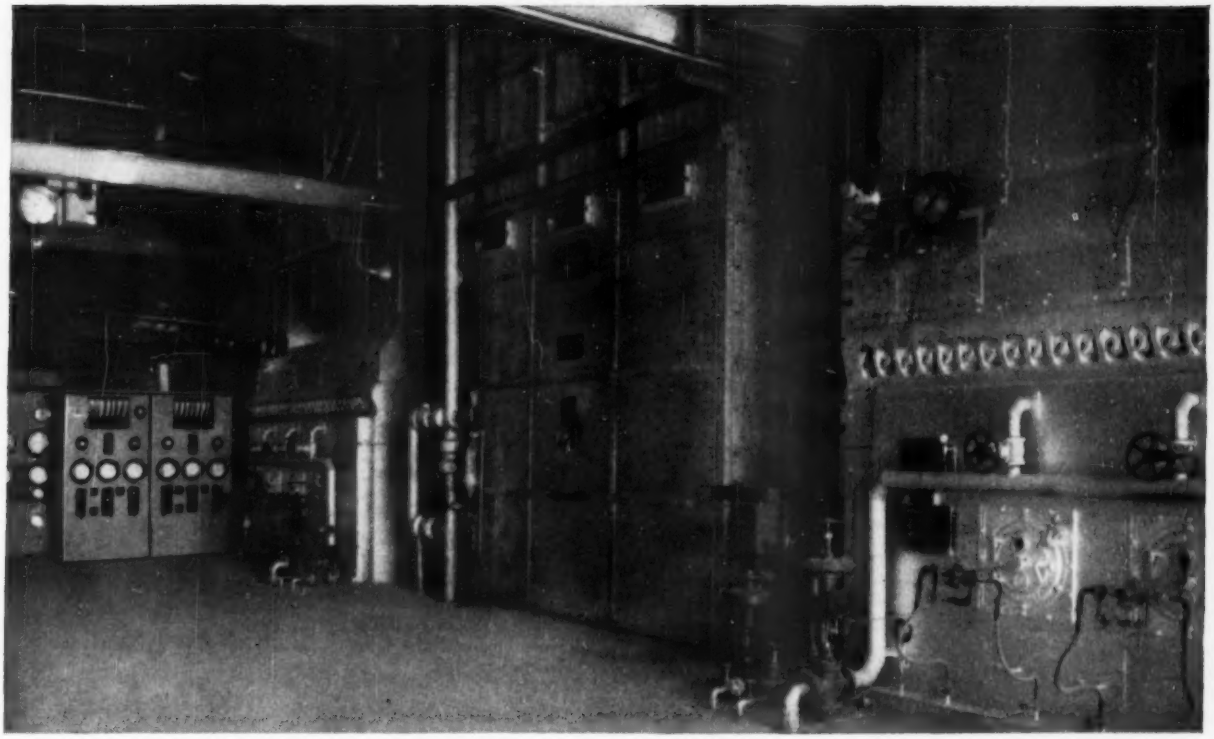
Go to College to



Instruments on the control panel monitor boiler operation. If desired, the entire combustion system can be operated manually from this panel.

● At Kansas State College, a complete Republic combustion control system, feedwater level controls and instruments automatically operate two 50,000 pounds per hour boilers for maximum combustion efficiency. Fired by either oil or gas, these boilers generate steam at 225 psig and 500° F.

With Republic automatic combustion controls in this power plant, all loads,



Cut Steam Costs

including "peaks", are met smoothly with steam output exactly matched to demand. Fuel costs per pound of steam produced are kept at a minimum 24 hours a day, seven days a week. Maintenance costs are kept low, too, by *continuous* proper operation of the boilers.

Whatever the size of your boiler, its draft arrangement, type or types of fuel to be fired and load conditions to be met, there's a Republic combustion control system that can bring these advantages to you. Our engineering staff, with more than 37 years *specialized* experience in combustion control systems, is at your service to help you get the system that exactly meets your needs. For your convenience, there's a nearby Republic field engineer to bring you all the facts. Write and make a date to see him soon.

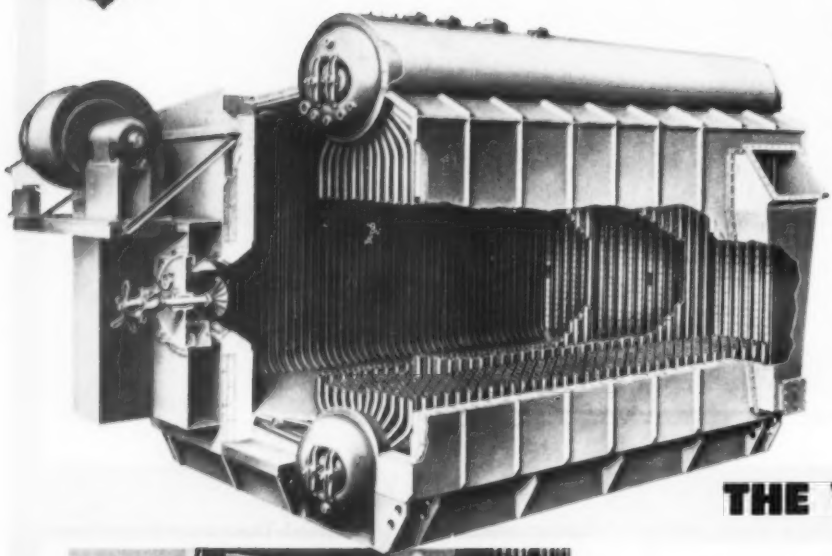
REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 524 on Post Card

FOR STEAM CAPACITY
choose your boiler

Whatever your fuel . . . whatever your steam capacity requirements up to 60,000 pounds per hour — you'll find one of the C-E Boilers shown here will be just right for you.

If you burn oil or gas, investigate the VP Pack-



Specifications — VP Boiler

Capacity — 4,000 to 30,000 pounds of steam per hour

Pressures — Up to 250 pounds per square inch

Temperature — No superheat

Fuel — Oil or gas

Erection — Completely shop-assembled

Foundation — Simple concrete slab

THE VP BOILER

The C-E Package Boiler, Type VP . . . completely shop-assembled . . . for oil or gas firing. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large (30-in. diameter) lower drum permits a simple, symmetrical, tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. The centrifugal fan is efficient, yet its noise level is less than half that of typical high-speed blowers used on most package boilers. Baffle arrangement is simple, resulting in low draft loss . . . simple soot blowing . . . elimination of dead pockets . . . high heat absorption. Write for Catalog VP.

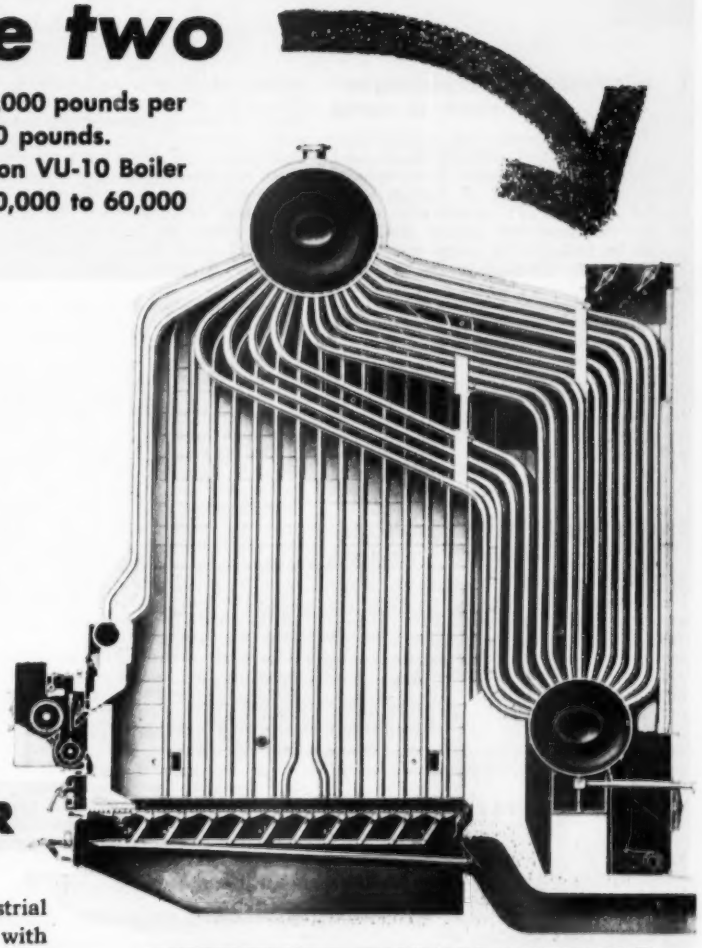
COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

UP TO 60,000 POUNDS *from these two*

age Boiler for capacities up to 30,000 pounds per hour . . . the VU-10 up to 60,000 pounds.

For stoker firing, the Combustion VU-10 Boiler is available in capacities from 10,000 to 60,000 pounds of steam per hour.



Specifications — VU-10 Boiler

Capacity — 10,000 to 60,000 pounds of steam per hour

Pressures — Up to 475 psi

Temperatures — Superheat available if desired

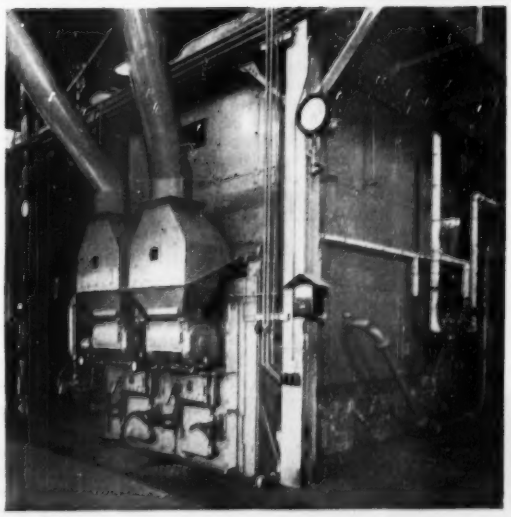
Heat Recovery — Economizers, air heaters available if desired

Fuel — Coal (C-E Spreader, Traveling Grate or Underfeed Stoker); oil or gas.

Erection — Field erected

THE VU-10 BOILER

The VU-10 Boiler is designed for industrial load conditions, particularly for plants with small operating and maintenance forces. Fuel can be either coal, oil or gas. This boiler is a completely standardized design adaptable to many conditions. It responds readily to variations in load; it is simple to operate and maintain. All parts are easily accessible for inspection. Like the VP, the VU-10 Boiler is a complete unit – boiler, furnace setting, fuel-burning equipment, controls, forced draft – bringing you the benefit of one contract . . . one guarantee . . . one responsibility. Write for Catalog VU 10-8. B-689



C·E

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE.

For more data circle 525 on Post Card

EQUIPMENT NEWS

Described here are recently announced products and processes. To request more information from the manufacturers, use Reader Service Cards on page 129

1—DEAERATORS are "packaged" units, ready to install

The Uni-Pac Deaerator is a package type unit specially designed for small and medium size power plants. It offers such plants the advantage of custom engineered features at practically stock prices, manufacturer points out, and it can be installed by plant personnel. The units are designed to deliver water up to full rated capacity; heat water to the full temperature corresponding to the saturated steam pressure maintained within the unit; and deliver deaerated water with an oxygen content less than 7 parts per billion. Outlet capacities of these deaerators range up to 60,000 lb per hour, and storage tank capacities from 35 cu ft to 250 cu ft. They are available in both right and left hand types — as determined by steam inlet facing tray door. Cochrane Corp.

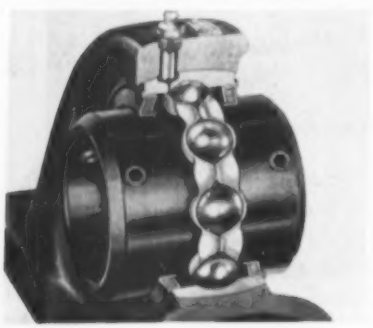
2—WATTHOUR METER is single-phase, universal type

Newest among this company's Type I-50 Single-Phase Watthour Meters is a universal meter. It incorporates advance design features of the standard model and is said to permit conversion to be made in the field from a two-wire, 120-v circuit to a three-wire, 240-v circuit, or vice versa, in approximately a minute. No additional parts are required and need for recalibration is minimized, company states. General Electric Co.

3—BALL BEARINGS have double extended race

Zone Hardened Sealmaster Ball Bearing Units with double extended race are now being manufactured. Zone hardening is described as a patented process for induction heat treating the inner race ring of these units — through the ball path section only. It is explained that since the extended portions of the race remain unaffected, the hardened threads of the set screws are able to bind tightly against the soft threads of the race for positive race to shaft locking. The double extension of the inner ring serves to provide maximum support of bearing on shaft and a positive lock between inner race of the bearing and the shaft.

According to manufacturer, this lock



reduces shaft wear and fretting corrosion, and as a result, machine "down time" is reduced since bearings can be easily removed for replacement and shafting is not worn and corroded beyond required tolerance for new bearing fit. Shock and vibration resistance are increased since most of the inner race remains relatively soft and tough. Bulletin 1053 gives further details on these bearings. Stephens-Adamson Mfg. Co.

4—METERING SYSTEM measures steam over a wide range

This engineered equipment package, utilizing two of manufacturer's Shuntflo Meters, is designed to permit measurement of steam over a wide range. The principle involved is the diversion of flow from a high-range to a low-range Shuntflo Meter, whenever the demand is low, by means of a compact change-over arrangement. It is pointed out that, by metering the extremely low flows which would otherwise not register on a meter properly sized to accommodate peak consumption, a heating company can receive compensation for all the steam used and thus increase the annual revenue.

Several other advantages are announced for this dual-range metering system. Among them are provision for metering over a wider range than would be possible with single-step meters; prevention of overload on low range meter; and elimination of need for changing meter capacities. Application Memo K19 covers a typical installation of this system now in use by a heating company in the metering of a building heating load. Builders-Providence, Inc.

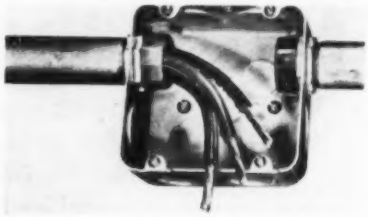
5—INTAKE-EXHAUST SILENCERS are improved absorption type

Developed for quieting the noise produced by air compressors, blowers, vacuum pumps and other machines expelling high velocity air to atmosphere, the Series CA and LCA are designed for operation under moisture-free air conditions and for temperatures up to 200 F. Both series are absorption type silencers employing straight-through acoustically transparent perforated tubes surrounded by a deep layer of special, highly efficient, sound absorbing material which can be used for operation at higher temperatures than standard 200 F. The CA Series is available in pipe sizes up to 6 in., and the LCA Series in sizes larger than 6 in. Burgess-Manning Co.

6—INSULATING BUSHING for rigid electrical conduit

Manufacturer of this insulating bushing says it will not shatter if struck by tools or dropped on a concrete floor during installation. For ½- to 6-in. standard rigid electrical conduit, the new bushing is made from a cellulose acetate butyrate formula for toughness and resiliency. It is UL approved, company points out, and conforms to National Electric Code requirements covering protection against damage to electrical wiring at the ends of raceways.

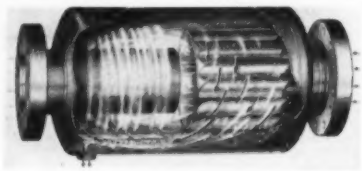
A fold-back throat covers jagged edges of the ends of conduits to keep them from damaging the wiring. Shaped for convenient gripping with the fingers, this



bushing is reported easily threaded on conduit, but a dual-purpose thread design acts to resist loosening from vibration. Because of its bright blue color, the bushing is quickly located. It is shown on conduit ends inside junction box. The Thomas & Betts Co.

7—MOISTURE SEPARATOR for use in horizontal lines

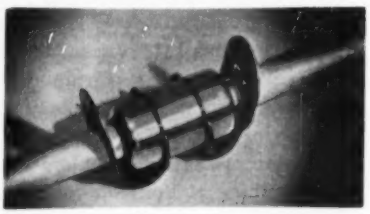
A refinement of this company's 30-N Separator for steam, air and gas lines, the new Type 31-N also installs in minimum space — occupying scarcely more space than the section of pipe it replaces. It is self-cleaning and may be used with



a wide range of pressures. Constructed of fabricated steel, this separator utilizes centrifugal force for removing entrainment, including water, oil and solids, from pressure line. Wright-Austin Co.

8—COUPLING simplifies tubing or pipe connection

The Meca Coupling has been designed to simplify the process of connecting tubing or pipe in any size range and for any purpose without the use of tools. The process is simply to press the spring



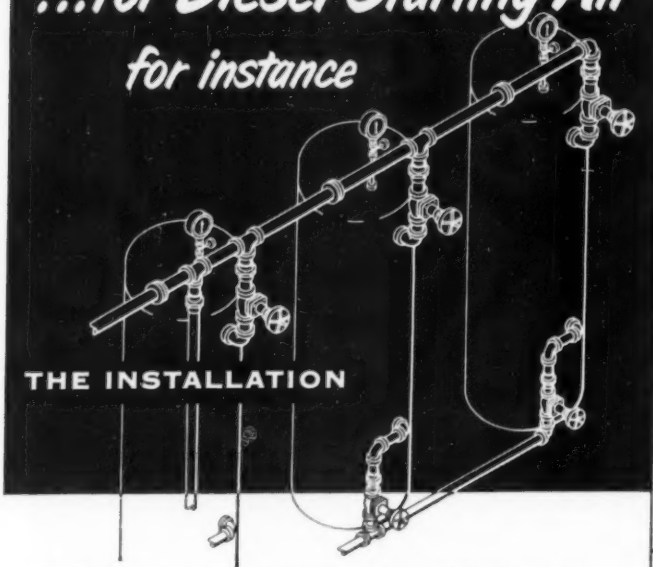
clip, insert tube into a sealed connection and release the spring.

At each end of the coupling are grooves containing rubber O-rings or rings made from other materials, depending on use. The sleeve is tapered on the inside to allow for any variation in the outside diameter of the tubing or pipe. The coupling has a stop in the center allowing an insertion of the tubing or pipe to fit equally into each side and the spring clip grips tighter as pull pressure is applied. The coupling will be available in a wide range of sizes. It will also be available in different materi-

If It's a Hard-to-Hold Fluid, Here's Your Valve

...for Diesel Starting Air

for instance



THE INSTALLATION

By Higgins, Inc., New Orleans ship building and repair yard, famous for PT boats . . . now using Crane heavy-duty all-iron valves for 250 psi diesel starting air systems on passenger and truck ferries, fishing boats, etc.

VALVE SERVICE RATINGS

SUITABILITY:	100% Effective
FEATURES:	Lead-faced disc
MAINTENANCE COST:	Rarely needs care
SERVICE LIFE:	Indefinite
OPERATING RESULT:	No loss of diesel starting air
AVAILABILITY:	Crane catalog item — No. 1504

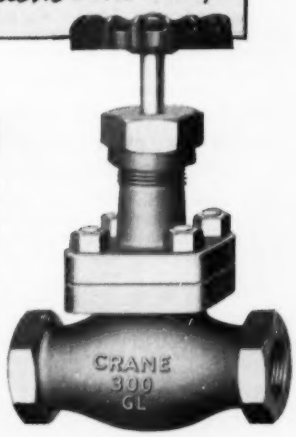
THE CASE HISTORY

By Higgins engineers' standards, marine diesel power is only as dependable as its starting equipment. Specifications are that a full charge be maintained in the starting air tanks overnight and longer. This, they found impossible with the conventional seating valves normally available for 250 psi working pressure.

But with Crane No. 1504 heavy-duty all-iron valves installed at the tanks, the problem was solved perfectly. These all-time favorites for dependable control of ammonia and other hard-to-hold fluids, are holding 250 psi starting air in the tanks indefinitely . . . and with valve dependability assured by Crane quality.

THE VALVE

Proved completely dependable in high-pressure ammonia, Crane No. 1504 all-iron globe valves are widely preferred for many air, oil, and gas services requiring the tightest seating, leak-proof body-bonnet joint, and extra-durable stem seal. Regularly supplied with lead face disc, or with steel seating for higher temperature and corrosive fluids. Sizes ¼ to 4 in.; flanged or screwed ends; also angle patterns. Ask your Crane Representative for Folder AD1977.



THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 526 on Post Card

als and with O-rings to suit various liquids, gases and temperatures. The Master Enterprise Corp. of America.

9—OPEN FUSE CUTOUT with greater contact area

The new open dropout fuse cutout, Type DX, for use on 5.2-, 7.8-, and 15-kv distribution systems, is claimed to be more rugged than earlier types; it has more contact area and sleet shields on both top and bottom contacts. A polyethylene coating on the metal clamps holding the metal parts to the porcelain insulator serves to prevent short circuits from birds.

This unit will accommodate a standard or heavy-duty fuse holder or a disconnect blade. The standard cutout fuse will interrupt 3000 amp at 5.2 and 7.8 kv, and 2000 amp at 15 kv; while the heavy-duty model handles 5000 and 4000 amp respectively. Both sizes have a 100-amp continuous current rating, while the disconnect blade has a 200-amp continuous current rating. Westinghouse Electric Corp.

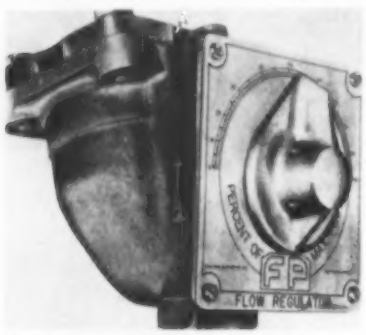
10—LEVEL CONTROL is designed for dry materials

Positive operation, resistance to wear of its sensing element, and the positive seal between sensing element and micro switch characterize this level control for dry material, according to manufacturer. The machine is placed on the side of bin or chute, and when material reaches a desired level, the stainless steel sensing probe trips the switch. There are no floats, paddles or diaphragms. The unit is designed to control any dry material, from wood flour to lead, weighing 5 to 500 lb per cu ft.

Downward action is exerted on sensing probe by the weight of material accumulated in the bin. The sensing probe is rigid straight back to the sensitivity spring and when materials reach the desired level, the sensing probe trips the switch. The control is also available in explosion proof and liquid level models. Descriptive literature is available. Scrayco Level Controls.

11—FLOW REGULATOR is low cost, self-operated unit

This automatic flow regulator is described as compact, simple in design, and easily maintained. It can be screwed directly into a pipeline and is designed to

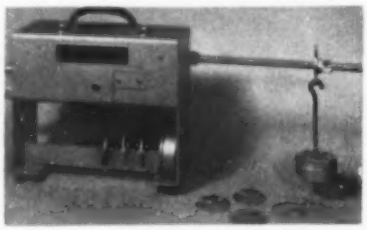


hold a pre-set flow rate despite changes in upstream or downstream pressure. Requiring no outside source of energy, it is operated by liquid passing through it. Manufacturer suggests it for flow control applications which do not justify the more costly pneumatic or electric control equipment, but are too complicated to be trusted to manually operated valves in connections with pumps or head tanks.

The regulator is adaptable to in-line or panel mounting, and can be mounted in any position, it is pointed out, because it is spring loaded — a factor also contributing to the unit's small size and light weight. The ½- 1- and 2-in. sizes in which the unit is available handle flow ranges of 0.5 to 5, 1.0 to 15 and 6 to 80 gpm. Fischer & Porter Co.

12—PNEUMATIC CALIBRATOR for testing pressure instruments

This new medium pressure calibrator has been developed for testing and calibrating pressure instruments which operate



between 20 in. water and 25 psi. Performing the same function as an air loader, the calibrator may be adjusted to produce any pre-determined pressure by adding or removing calibrated weights from a weighbeam. Setting output pressures with a manometer is not necessary, it is pointed out. This instrument is portable and can, in many cases, be used for checking instruments without removing them from their mountings. It operates from a 35 psi air source. Form 53-3 gives full data on this calibrator. Republic Flow Meters Co.

13—CURRENT TRANSFORMERS for outdoor application

Type JKW-3, a new butyl-molded current transformer for outdoor applications up to 5000 v, is smaller and lighter than company's previous models. It is said to represent the first successful application of the butyl process to transformers of the higher-voltage outdoor type. Company engineers say the previous maximum voltage for such transformers was 600 v, although 5000 v was the high for indoor use.

The entire exposed surface of the transformer is said to be corrosion-resistant and is expected to reduce maintenance to a minimum. Possible bushing breakage has been reduced by use of butyl. The secondary terminal box is molded in the case and, with the butyl acting as a gasket, the aluminum cover provides water-tight protection, it is claimed. Primary coils are of the "figure 8" type for mechanical strength. Low core losses and high accuracy are said to result from the inter-leaved, high-permeability silicon-strip steel core. General Electric Co.

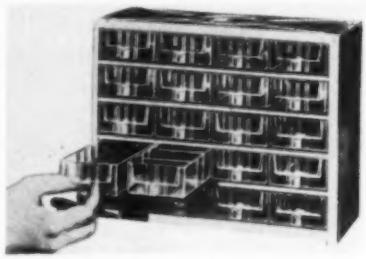
14—TANK GAGE for remote reading applications

The Keco Tank Gage, for use with vented fuel oil, gasoline and diesel tanks to 9 ft. depth, is designed to permit gaging of fuel level in inches at a reasonable distance from the tank and at any desired elevation. The etched-aluminum scale plate has four different scales to permit using gage with fuels at a wide range of API gravities. Only one scale is visible at any time, and if the grade of fuel is changed, the scale plate can be turned to bring the proper scale into reading position.

Working as a frictionless hydrostatic balance, the gage has no moving mechanical parts except for a small air pump built into the case, which is of molded nylon. All parts in the tank are steel. Installation consists of mounting a ½-in. pipe in the tank, placing the gage on a wall or column and connecting a ¼-in. copper tube from the tank to the gage, which is 8½ in. high by 2¼ in. by 2¼ in. over all. Bulletin 375 gives full details. King Engineering Corp.

15—DRAWER CABINETS for visible storage of small parts

See-Thru Drawer Cabinets are made with clear plastic drawers which, according to manufacturer, are spillproof and lifetime-guaranteed. The popular Model J-20 has 20 such drawers in a welded steel cabinet with silver-gray hammer finish and rubber feet. The individual drawers are 5⅛ in. long by 2¾ in. wide by 1 7/16 in. high, and the overall size of the cabinet is 10¼ in. high, 12½ in. wide and 6 in. deep. Adjustable drawer dividers and identifica-



tion labels are included and the unit is priced at less than $8.00 postpaid.

Other cabinets in this line have from eight to 128 drawers; some have larger size or metal drawers, and some have carrying handles. Over 750 combinations can be supplied, says manufacturer, and literature on them is available. General Industrial Co.

16—ADJUSTABLE V-BELTS are easily coupled, uncoupled

Veelos TD and TE Link V-Belts for D and E drives are made of plies of treated high-tensile strength canvas duck, joined by riveted studs with removable cap-washers and T-screws. This construction is said to give greater strength and durability at key points, yet enable the belts to be coupled and uncoupled easily. According to manufacturer, they're the easiest V-belts to couple and uncouple ever made. They're also claimed to provide maximum flexibility to last longer and run cooler.

Coal pulverizers, compressors and fans and blowers are typical power plant installations for which these belts are suggested. Two types are available: regular rubber coated for general services, and oil-proof for oily and high temperature drives. Manheim Mfg. & Belting Co.

17—PRESSURE CELL for measurement of fluid flow

A precision type differential pressure cell based on SR-4 resistance wire strain gage measurement, the new Type MMB is made in two ranges: ± 15 psi and

Whatever your fuel needs, we have a coal that is

Just the Ticket!

● In fact, you can write *your own* ticket—for the vast Bituminous fields served by the Baltimore & Ohio contain excellent coals *in wide variety*. For centuries to come, these coals will be available—a dependable source of low-cost heat and energy.

Modern mechanization at the mines assures low costs as well as uniform size and quality. The location of the fields—close to industry's front door—contributes to low transportation expense. Storage is economical because costly facilities are not required. And with the help of new combustion methods and equipment, Bituminous offers its users an increased burning potential.

ASK OUR MAN! He can give you worthwhile advice as to supply sources and burning methods for the particular coal you need. The efficiency, economy, and cleanliness of B&O Bituminous today will be a revelation!

BITUMINOUS COALS FOR EVERY PURPOSE

LINKING 13 GREAT STATES WITH THE NATION

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!

For more data circle 527 on Post Card

30 psi. Maximum base pressure is 40 psi. According to manufacturer, the cell can be used advantageously in process control instrumentation for measuring fluid flow, such as gas, water, or chemicals through pipe lines. In this service the advantages noted are long distance transmission of signals without lag or time delay, using low voltage circuits, and good fatigue life.

Pressure taps are designed to take small rubber tubing or may be provided with ¼-in. pipe thread. By evacuating one side of the MMB Cell it becomes an absolute pressure pick-up, it is noted. Baldwin-Lima-Hamilton Corp.

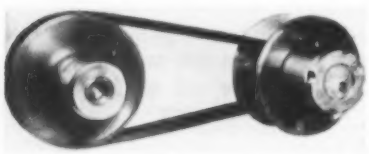
18—SOLVENT CLEANERS with high flash point for safety

Cleaning efficiency and fire safety, even on aluminum and other soft metals, are advantages announced for two new solvent emulsion cleaners, Navee '53 and Hi-Flash. Both have a flash point of 250 F, according to manufacturer, and this high flash point is constant — doesn't vary even when heated.

Navee '53 is an extra-heavy duty degreaser for removing hardened, oxydized and burned-on oils and grease, as well as carbon stains, preservative coatings, lead oxide, packing greases and asphalt tar. Mixed with five to 10 parts water, it is said to combine the cleaning efficiency of solvents with the rinsability of detergents. Hi-Flash is described as an industrial degreaser which removes drawing, cutting and lubricating oils and polishing rouges from metal parts. Company says it can be used concentrated or mixed with water at room temperature or hot. The Penetone Co.

19—VARIABLE SPEED UNIT offers flexibility in operation

The Icor Stepless Speed Variator is said to represent a new approach in variable speed units. An essential feature announced for the pulley is a control device that keeps both halves continuously centered with the center line of the belt



itself. Both control device and bearings are said to be free of load or stress to assure maximum service life under hard running conditions, and the V-belt always automatically stretched.

An important advantage attributed to this variable speed unit is the possibility of using it as driving or as driven pulley. It requires no more space than other pulleys, says manufacturer, and it is not necessary to alter the distance between driving and driven pulleys to regulate the number of revolutions. It is pointed out that elimination of slide rails and pulley casings contribute to both a more pleasing appearance and a more practical design at lower construction cost.

Any speed within a ratio to 1 to 16 is attained by using, simultaneously, a driving and a driven pulley. Both pulleys can be mounted on any motor or machine; they may be reversed 180 deg, can drive in any direction, and can be used for horizontal or vertical drives. Six sizes offer capacities from ½ to 25 hp. Gubelin International Corp.

You may use the post cards provided on page 129 to ask for further information on any of these new products

20—AUTOMATIC BURNER for oil, gas, or combination firing

Designed for fully automatic operation, the Model PK-54 Burner is sized for capacities to 42,000 lb of steam per hour. The unit includes burner and blower, also entire system of combustion, flame-safeguard, and operating-sequence controls. It is enclosed in a console-type gray cabinet of heavy gage steel.

According to manufacturer, a major advantage of the PK-54 is adaptability of installation. For example, a pump and heater set may be close-coupled by simply connecting lines for oil supply, oil return, steam, and condensate. Remote location of pump and heater set is declared equally simple. Similarly, the complete control cabinet may be close-coupled to the burner-blower unit as an integral part of the burner, or may be remotely located. Also, it is pointed out, the burner-blower unit can be floor mounted on a concrete base (for conversions and low-set boilers) or it can be mounted directly on the boiler front. Bulletin 430 gives details on this burner. Peabody Engineering Corp.

21—D-C MOTOR is totally-enclosed and unit-cooled

Smallest standard model of its type, this totally-enclosed, unit-cooled d-c motor is intended for use in severe atmospheres. It was developed for application in machine-tool, paper, cement, chemical, rubber, and steel-mill industries, and in materials handling operations. Available in ratings from 15 to 200 hp, it is said to feature 50 per cent greater heat transfer in a 37 per cent smaller unit than company's previous designs.

Compact cooling units, mounted within the over-all length and width of the motors, are utilized to permit operation at extremely low speeds for long periods of time because ventilation is independent of motor speed. A double system of blowers is used for rapid cooling. One blower assembly forces cooling air from the room through the external passages of the cooler, while the other forces internal motor air through the closed internal passages of the air cooler. The blower motors, totally enclosed type, are for three-phase, 60-cycle power supply. Blower controller is a simple magnetic switch which can, at extra cost, be interlocked with the main controller so both are started simultaneously. A thermostatic relay protects the main motor in case of blower-motor failure. General Electric Co.

22—MOLDED OIL SEALS incorporate improved design

The LPD Clipper Seal is a new addition to this company's line of all molded oil seals. The initials LPD stand for "line-contact proportionate design." "Line-contact" refers to the lip of the seal which contacts the shaft in a thin line around the shaft circumference. This is claimed to result in minimum seal wear, low frictional heat and less drag on the shaft. The narrow lip bearing area also reduces the need for lubrication, it is explained, yet the seal receives more lubrication in proportion to its surface.

"Proportionate design" refers to the relationship between lip area and hinge area which stay proportionately the same throughout the range of flange widths and shaft sizes. In this design the lip is husky in cross section and the hinge is proportionately sturdy. The hinge controls lip contact and its flexibility lets

the seal adapt itself to shaft run-out and minor shaft eccentricities. This lip area provides a deep retainer groove for the garter spring which holds the lip in contact with the shaft.

Final feature of the seal is the composition heel. It is designed for a press fit into the bearing cavity, and since the heel is a composition material, it will conform to irregularities. Machining of the cavity to close tolerances is unnecessary, it is said, and because of this heel the LPD Clipper Seal can be removed and replaced without damage to seal or cavity. Johns-Manville.

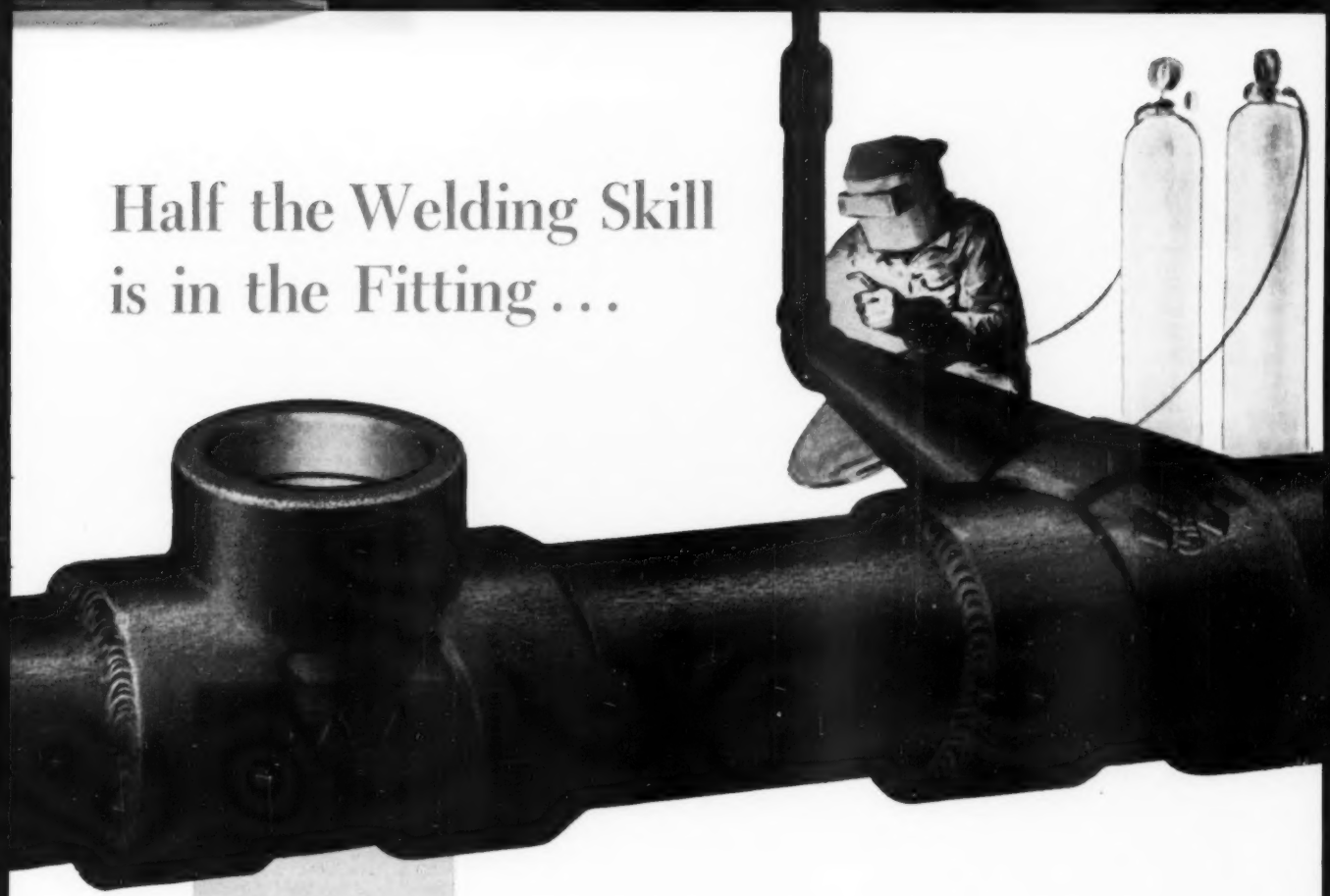
23—TIME DELAY RELAY is compact, hermetically sealed

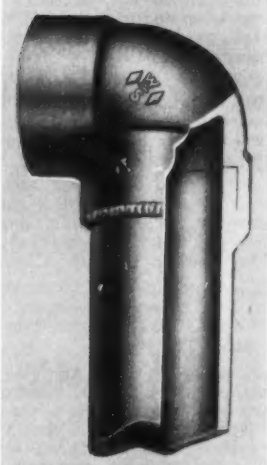
Originally developed for use in aircraft, the Type SF Agastat is also suggested for use in industrial control devices which must operate in wet, corrosive, dusty, or explosive atmospheres. It is said to be unaffected by freezing temperatures, and to be resistant to vibration, shock and acceleration. It is a solenoid-operated, pneumatically-controlled time delay relay housed in an enclosure only 2¼ in. square and 4 in. high. It weighs 1.2 lb. Time delay is adjustable from outside the housing.

The Type SF Agastat is designed for applications where its solenoid coil will be energized only momentarily. Time

delay begins upon de-energization of the coil. Currently manufactured for 24 to 28 v d-c, the new relay will be available for other standard voltages, both a-c and d-c. It is made with double-break contacts; single, double or three-pole. Elastic Stop Nut Corp. of America.

Half the Welding Skill is in the Fitting . . .





WATSON-STILLMAN FORGED STEEL SOCKET-WELDING FITTINGS make your pipe welding jobs easier three ways:

1. The fittings themselves support and align the pipe—no need for special fixtures or tack welding. Just slip the fitting over end of pipe and weld.

2. No chill rings are needed. Welding "icicles" can't form inside the pipe. Socket welding is actually lap welding—not butt welding.

3. Ample "come-and-go" in socket makes fussy accurate measurement and cutting of pipe unnecessary.

WATSON-STILLMAN FITTINGS are drop forged of highest quality steel to produce the well-known forged-fiber structure for maximum strength against pressure, temperature, shock and vibration. Extra strength is built-in in other ways, too—such as the extra reinforcement of long bands extending well beyond the bottom of the socket.

W-S SOCKET-WELDING FITTINGS are also available in forged stainless and alloy steels for exceptional service at high and low temperatures and for maximum resistance to corrosion. Write today for information.

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, N. J.

For more data circle 528 on Post Card

CONSTRUCTION NEWS

Denver, Colo. — Public Service Co. of Colorado, Denver, has plans for addition to local steam-electric generating station, with installation of equipment for increased capacity. Bids have been asked for structural steel framing and work on superstructure will begin soon. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Stratford, Conn. — Sikorsky Aircraft Division, United Aircraft Corp., South Ave., Bridgeport, Conn., plans steam power house at proposed new plant at Stratford, for manufacture of helicopters and parts. It will comprise several large buildings and is estimated to cost about $15,000,000. Project will be carried out in 1954. Albart Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., is architect and engineer.

St. Petersburg, Fla. — Florida Power Corp., St. Petersburg, has arranged for sale of a bond issue to total $10,000,000, a considerable part of proceeds to be used for expansion and improvements in power plants and system, including work on new steam-electric generating station at Ellaville, Fla., recently authorized.

Athens, Ga. — General Time Corp., 109 Lafayette St., New York, N. Y., plans steam power house at proposed new plant for manufacture of electric clocks at Athens, Ga., where tract of about 55 acres of land has been selected. It will comprise several buildings for parts production and assembling, with project reported to cost close to $2,000,000. Work will be carried out in 1954.

Morris, Ill. — Maytag Corp., Newton, Iowa, washing machines and other laundering equipment, plans steam power house at new branch plant at Morris. It will comprise a main one-story building for parts production and assembling, and several smaller units, reported to cost close to $3,000,000, with equipment. Work is scheduled to be carried out in 1954.

Rockford, Ill. — Central Illinois Electric & Gas Co., 303 North Main St., is arranging a fund of about $1,500,000, through sale of a block of preferred stock, proceeds to be used for extensions and improvements in plants and system, including preliminary work in connection with expansion of local Seabrooke steam-electric power plant, recently referred to in these columns.

Rock Island, Ill. — Iowa-Illinois Gas & Electric Co., Rock Island, plans an expenditure of about $10,400,000 in 1954 for extensions and improvements in power plants, transmission lines, power substations and miscellaneous construction. Generating capacity will be increased.

Jasper, Ind. — Municipal Light and Water Dept., has approved plans for new municipal power plant, using Diesel engine-generating units, and will carry out work soon. Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa, is consulting engineer.

New Albany, Ind. — Public Service Co. of Indiana, Plainfield, Ind., has authorized plans for new steam-electric generating plant in vicinity of New Albany, with turbine-generators, high-pressure boilers and auxiliary equipment for large capacity. Entire project of power substations, transmission lines and other field structures, will cost close to $40,000,000. Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., are consulting engineers.

Lawrence, Kan. — Kansas Power & Light Co., 700 Massachusetts Ave., has completed plans for expansion in local steam-electric power plant, with installation to include a new turbine-generator, high-pressure boilers with rating of 425,000 lbs. of steam per hr., cooling tower and auxiliary equipment. Entire program is estimated to cost about $8,500,000. Work will proceed at once, with completion scheduled early in 1955.

Louisville, Ky. — Louisville Gas & Electric Co., 311 W. Chestnut St., has authorized expansion in new steam-electric generating station, now in course of construction on Ohio River, near city, with installation of a second turbine-generator unit of 100,000-kw. rating, and accessories. Program estimated to cost in excess of $13,000,000. Work will proceed at early date.

Krotz Springs, La. — Gulf Refining Co., Gulf Bldg., Houston, Tex., plans steam-generating station at new cycling and natural gasoline plant at Krotz Springs (St. Landry Parish). It will consist of a large series of buildings, equipped to process about 100 million cu. ft. of natural gas per day, with by-products division for extraction of butane, propane and other liquids. Entire project will represent a reported investment of approximately $10,000,000. Program will be carried out in 1954.

River Rouge, Mich. — Detroit Edison Co., 2000 Second Ave., Detroit, Mich., has foundations under way for proposed new steam-electric generating station at River Rouge, previously noted in these columns, and will proceed with superstructure soon. Work is also in progress on new power plant at St. Clair, Mich. To provide for these and other expansion and improvements in generating stations and system, company has arranged financing through sale of bonds, totaling $43,350,000.

Aurora, Minn. — Erie Mining Co., care of Pickands, Mather & Co., Union Commerce Bldg., Cleveland, Ohio, operator and manager, plans large steam-electric generating station at new taconite mining plant at Aurora. Project will include a number of buildings for mining and reduction service, equipped for capacity of 10,500,000 tons per annum. Work is scheduled to be placed under way in 1954. Cost reported in excess of $290,000,000. Engineering Dept., Anaconda Copper Mining Co., 25 Broadway, New York, N. Y., is engineer for project.

Macon, Mo. — Municipal Light and Water Dept., plans expansion in municipal steam-electric power plant, with installation of new turbine-generator unit and auxiliary equipment. Entire project is reported to cost close to $700,000. Proposed to carry out work in 1954.

Pennsauken Township, N. J. — United States Steel Products Division, U. S. Steel Corp., 30 Rockefeller Plaza, New York, N. Y., plans steam-generating station at proposed new plant in Pennsauken Township, where tract of land has been selected fronting on Delaware River. It will consist of several buildings, equipped for manufacture of steel drums and other steel containers. Cost reported in excess of $1,500,000. Work is scheduled to begin early in 1954.

Point Pleasant, N. J. — Jersey Central Power & Light Co., 501 Grand Ave., Asbury Park, N. J., has plans maturing for new steam-electric generating station in vicinity of Point Pleasant, where tract of land is being selected. Installation will include a 137,500-kw. turbine-generator, high-pressure boilers and auxiliary equipment. No official estimate of cost announced. Completion is scheduled in 1955.

Preakness, N. J. — United States Rubber Co., 1230 Ave. of Americas, New York, N. Y., plans large boiler plant at new laboratory and research center at Preakness (Wayne Township), where tract of about 90 acres of land has been purchased, to be used for central steam supply for group of several buildings. Entire program is estimated to cost about $4,000,000. Proposed to begin work soon.

Buffalo, N. Y. — Niagara Mohawk Power Co., Buffalo, has disposed of a bond issue totaling $40,000,000, proceeds to be used in connection with 1954 expansion and improvement program, including generating stations, power substations, transmission lines and other operating facilities.

Akron, Ohio — Ohio Edison Co., Akron, is arranging financing in gross amount of $50,000,000, a considerable part of proceeds to be used for expansion and improvements in generating plants, where increased capacity will be carried out, power substations, transmission lines and other operating facilities.

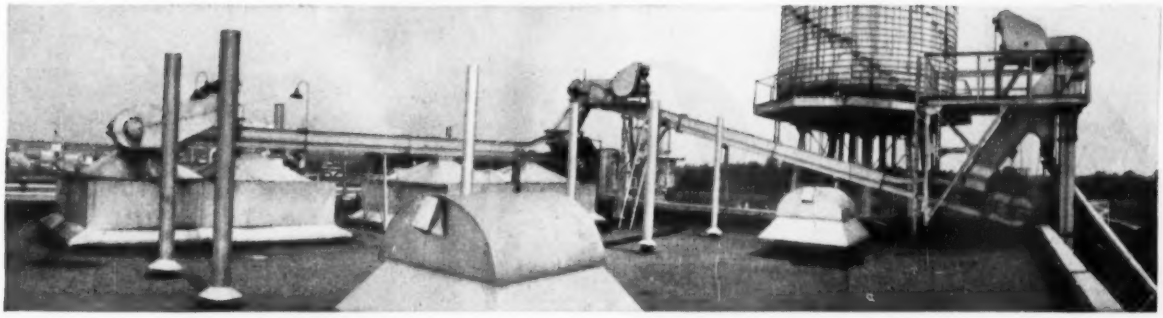
Columbus, Ohio — Columbus & Southern Ohio Electric Co., 215 North Front St., has disposed of a bond and stock issue totaling $15,000,000, proceeds to be used for expansion and improvements in power plants and system, including enlargement of Picway generating station, near city, recently noted.

Philadelphia, Pa. — Philadelphia Electric Co., 1000 Chestnut St., has disposed of a bond issue totaling $20,000,000, proceeds to be used for increased generating facilities, extensions in power substations, transmission lines and other work.

Chillicothe, Tex. — Chillicothe Chemical Mfg. Co., care of Henry Brandon, 5311 Columbia St., Dallas, Tex., lately organized by Mr. Brandon and associates, plans steam power plant at proposed new commercial fertilizer plant at Chillicothe (Hardeman County), where site has been selected. It will comprise a number of one and multi-story buildings, equipped for large output. Entire project will represent a reported investment of about $15,000,000. Proposed to carry out work in 1954.

San Antonio, Tex. — Jacob E. Decker & Sons, Inc., 114 Blue Star Ave., meat processor and packer, plans steam power house at new local plant, comprising several buildings, equipped for large capacity. Cost estimated close to $1,000,000. Work will begin soon. Main offices are at Mason City, Iowa. Company is a subsidiary of Armour & Co., Inc., Chicago, Ill.

Anacortes, Wash. — Shell Oil Co., 100 Bush St., San Francisco, Calif., plans power plant at new oil refinery near Anacortes, where site has been secured. It will consist of a large group of one and multi-story steel frame structures for different divisions of processing and production, with total cost reported at close to $50,000,000. Work is expected to begin early in 1954.



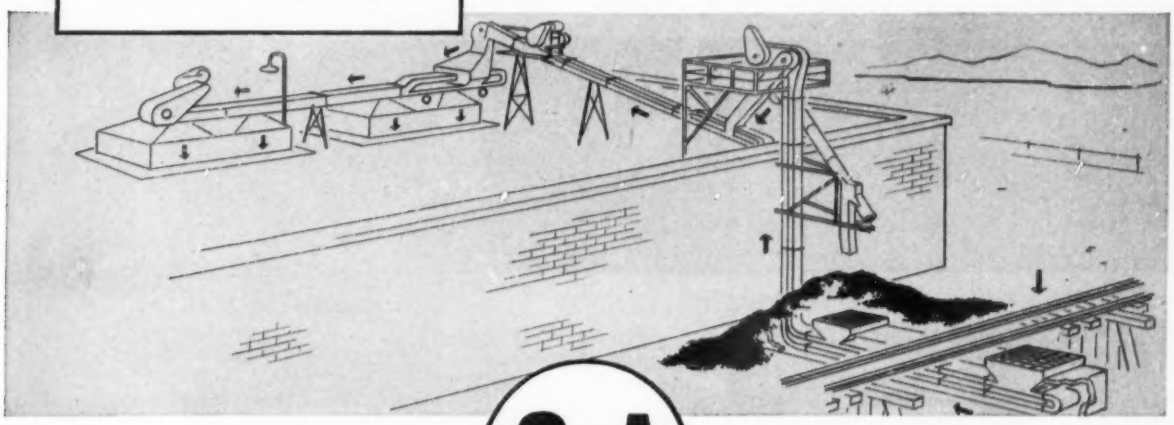
THIS S-A CONVEYING System Cut Construction Cost by Moving Coal Over the Roof

This S-A REDLER Conveying System utilizes "dead" rooftop space for a high capacity, multiple-discharge feed line for stoker hoppers. Construction costs were minimum, because the enclosed REDLER needs no shelter from the weather. Hopper capacity is greater, since there are no conveyors inside the building to take up headroom. And, of course, spotless-clean, dust-free REDLER handling is a big advantage for this finishing plant.

Here, as usual, S-A engineering goes beyond mere provision of "adequate" conveying. It capitalizes on a complete line of efficient bulk handling equipment—a line so complete that there is a conveyor or combination to meet every problem of plant layout, *including yours*. Write for a free survey.

BISHOPVILLE FINISHING COMPANY
Division of REEVES BROTHERS
Bishopville, South Carolina

Coal is fed to double-leg, horizontal run of L-type REDLER Conveyor through track hopper or yard storage hopper. The 11-in. REDLER handles minus 3" coal at a rate of 35 tons per hour, carrying it horizontally for 47 feet, then up 56 feet to the top of the boiler house. Here it feeds a 44-foot slope REDLER, which, in turn, feeds a horizontal REDLER charging into four coal hoppers. Selective discharge is controlled by rack and pinion gates.



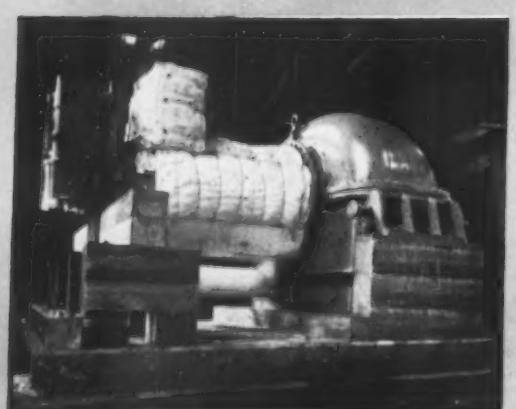
STEPHEN S-A DAMSON MFG. CO.

86 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

For more data circle 529 on Post Card

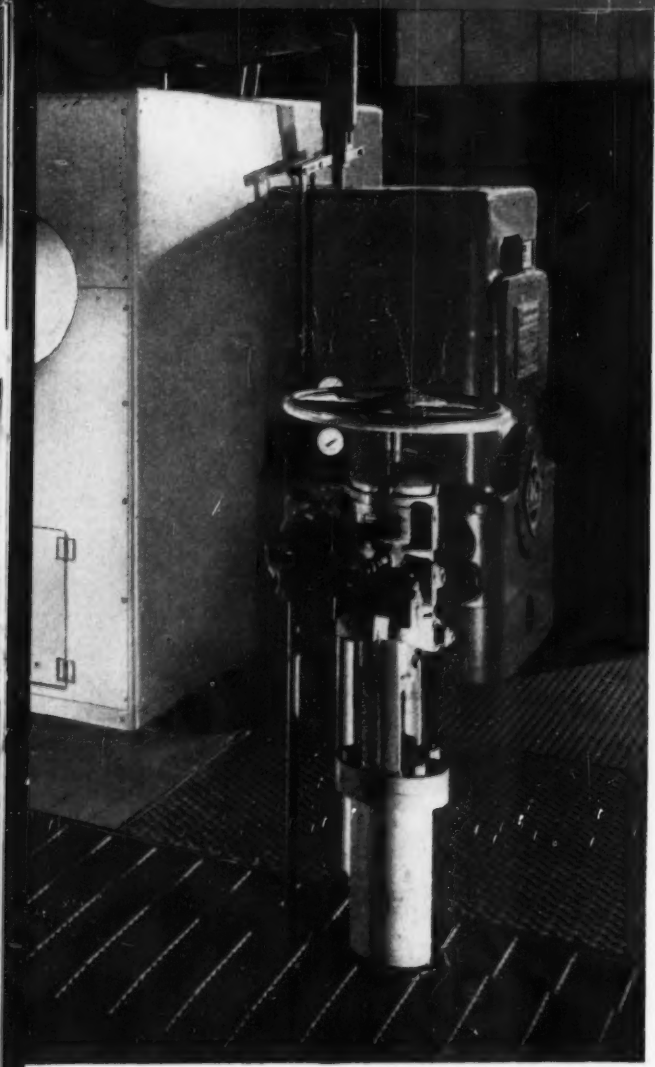
Another



To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series
STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE's another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

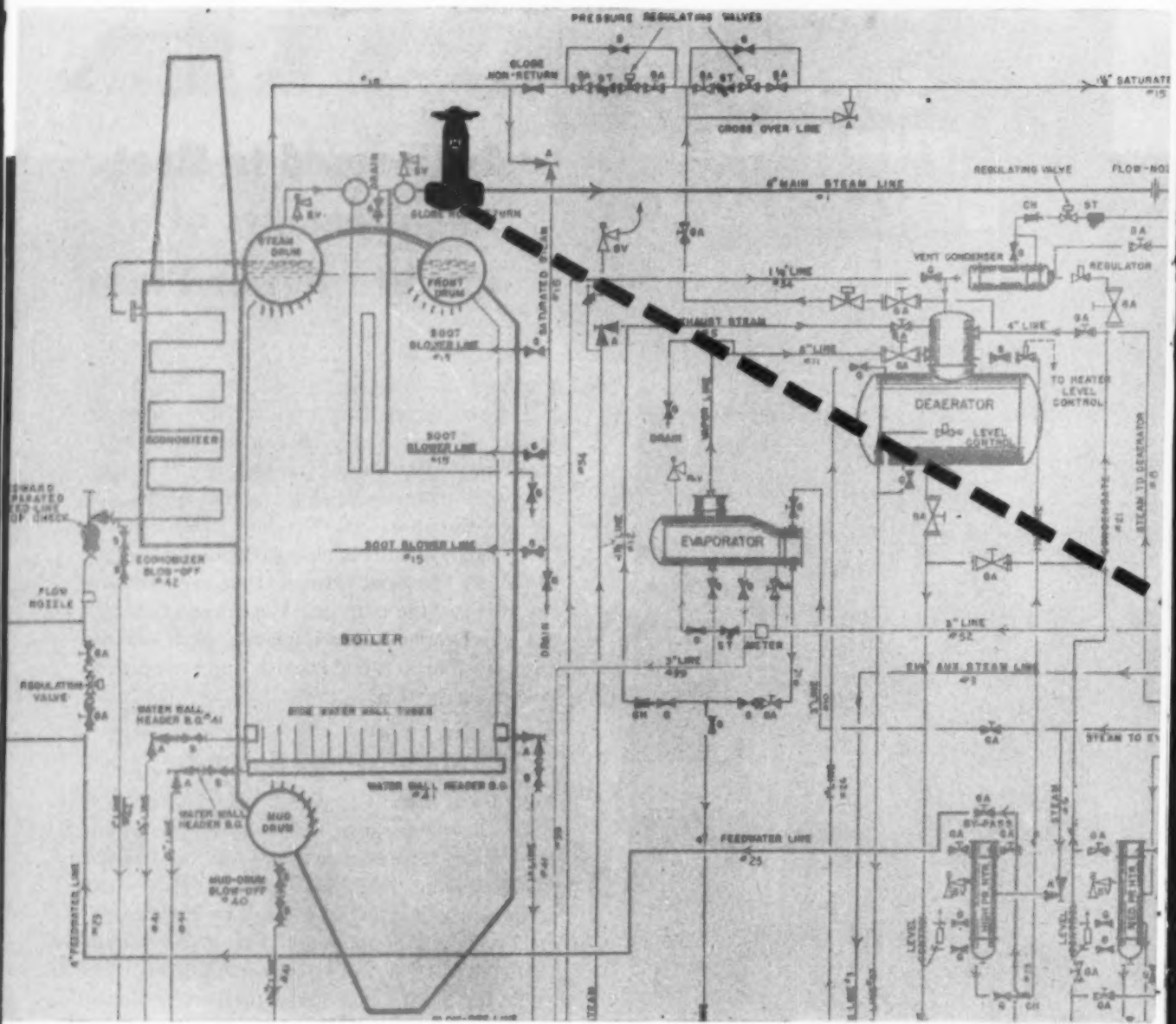
For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

What you should know about



Essential to boiler safety is a non-return valve, required to prevent flow of steam from the main header into a boiler which is temporarily below header pressure. Edward non-return valves are installed on an overwhelming majority of the nation's principal power plant boilers.

BOILER CODE REQUIREMENTS

When two or more boilers are connected to a common header, the steam connection from each boiler must be fitted with two stop valves, preferably consisting of one automatic non-return valve set next to the boiler and a second valve of the outside screw and yoke type.

The non-return valve must be rated:

1 At 100% of the set pressure of the drum safety valve at the corresponding saturated steam temperature.

2 At 100% of the minimum set pressure of the super heater safety valve at the super heated steam temperature.

3 At 85% of the lowest set pressure of the boiler drum safety valve at the expected temperature at the super heater outlet.

Reference P 302, P 303, Rules for Construction of Power Boilers, 1952.

INSTALLATION POINTERS

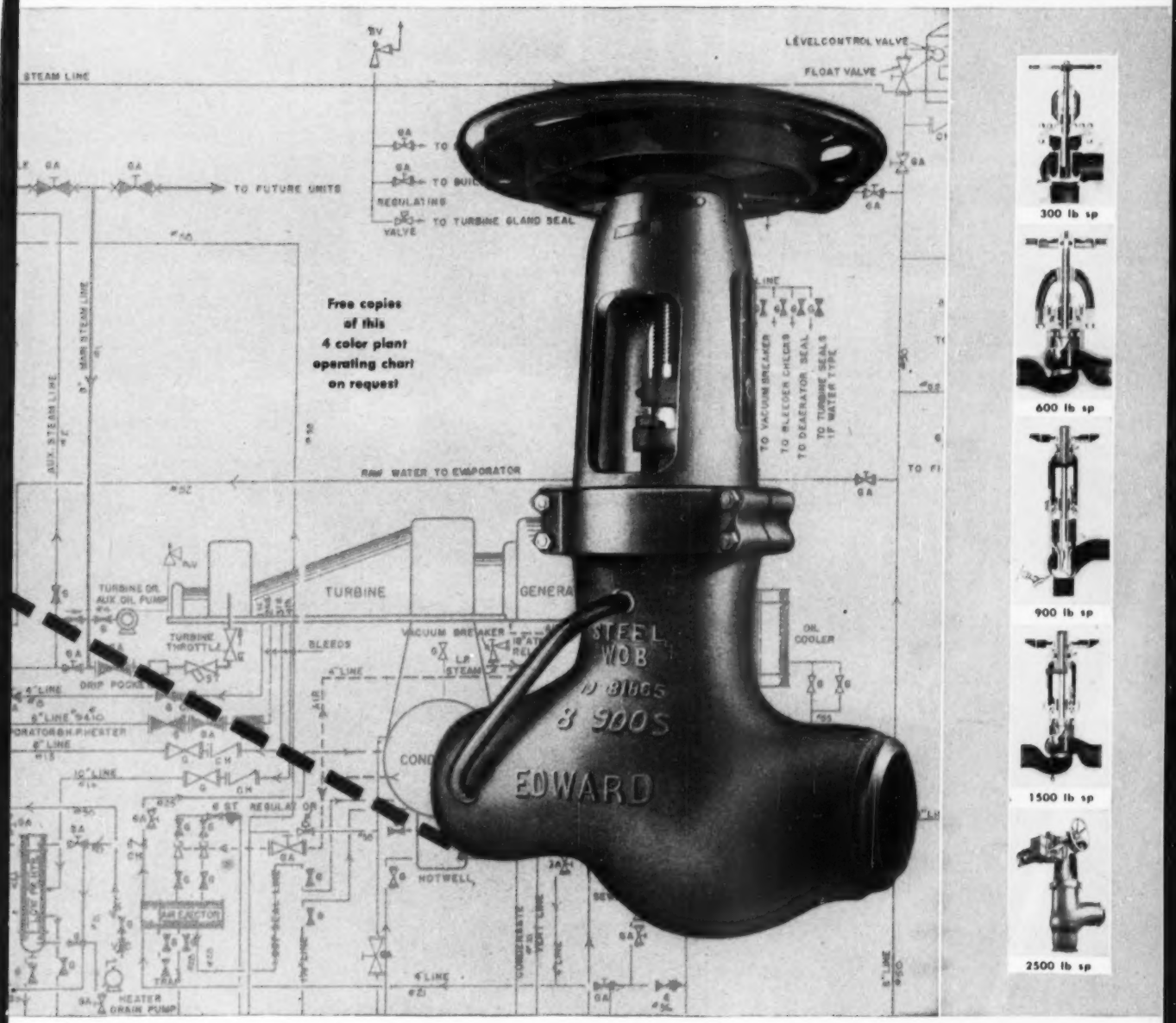
The non-return valve should be installed:

1 So that it can be readily manipulated by hand as a stop valve.

2 So that the disk piston is in a vertical plane. Avoid installations where the disk piston travels on an angle, thus providing the possibility of hang-ups and incomplete closure.

3 With an Equalizer, where operating conditions require wide variations in flow rates. The Equalizer, a piping connection between the high pressure area over the disk piston and the low pressure, high velocity outlet, causes the disk piston to be sucked up into the bonnet chamber, which gives it a firm support and provides vibrationless operation. The flow passages in the valve are left wide open for minimum pressure drop.

NON-RETURN VALVES*



4 On the boiler lead just after the superheater safety valve. An Edward gate valve is recommended as the second stop valve required by the boiler code which also stipulates that a drain must be installed between the two valves so that its discharge is visible while the operator is manipulating the valve.

SELECTION POINTERS

Be sure your non-return valve has:

1 A simple uncomplicated design—avoid gadgety constructions and involved mechanisms which can cause trouble and fail in operation.

2 A closing mechanism which insures drop tight closing at boiler test pressures. A great asset here is the Edward Impactor Handwheel which allows an operator to apply 2.8 times the closing force of ordinary handwheels.

3 Forged stainless steel piston rings. Insistence on forged rings will eliminate disassembling of valve to remove pieces of broken piston rings from the flow passages.

4 Body contours which have been specifically designed and tested for minimum pressure drop.

5 Integrally cast mirror smooth guide ribs, which govern the path of the disk piston during its entire travel. Stem guided disk pistons may cause faulty alignment during the last stages of travel, the most critical part.

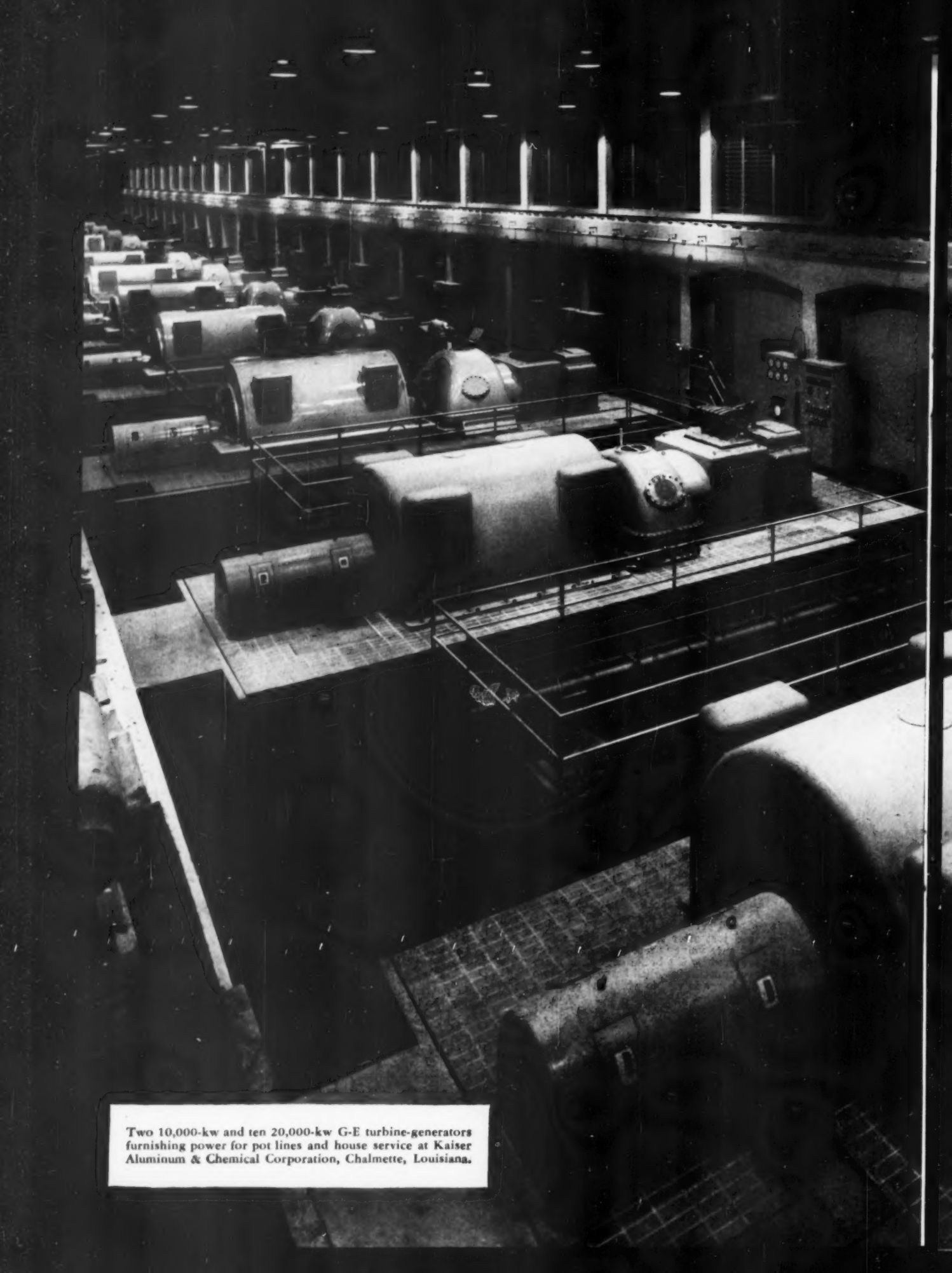
6 Light weight disk piston of hourglass design for maximum piston lift and low pressure drop.

For complete information on non-return valves write for a copy of catalog 12-B to Department NR, Edward Valves, 1200 West 145th St., East Chicago, Indiana.

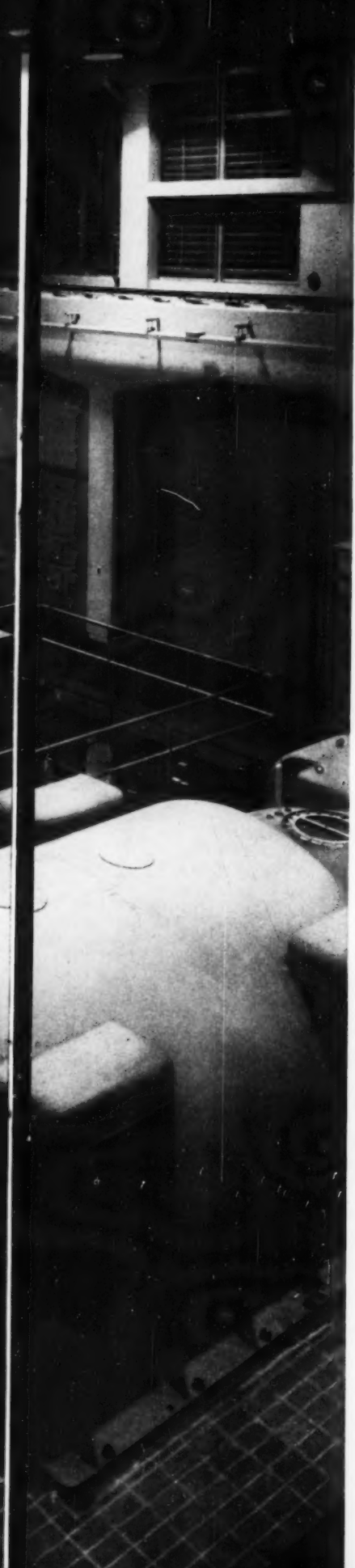
*One of a series providing condensed information on valve applications in steam power plants.

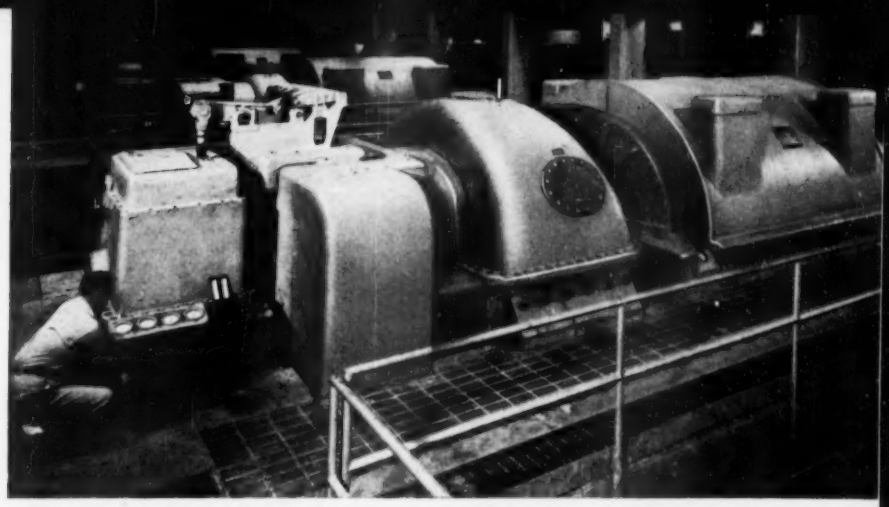
Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
220 W. 144th ST.
EAST CHICAGO, INDIANA

Another Product



Two 10,000-kw and ten 20,000-kw G-E turbine-generators furnishing power for pot lines and house service at Kaiser Aluminum & Chemical Corporation, Chalmette, Louisiana.





G-E Service Engineer making final inspection of 20,000-kw G-E turbine-generator at Kaiser Aluminum & Chemical Corporation. Two 10,000-kw units in background furnish power for house service.

Kaiser Aluminum Operates Sixteen G-E Turbines in Huge New Plant

KAISER ENGINEERS SELECT G-E TURBINES FOR QUICK DELIVERY; 12 UNITS FURNISH POWER FOR POT LINES; FOUR OTHERS SUPPLY ALL PLANT SERVICES.

When Kaiser Engineers planned the new Kaiser Aluminum and Chemical Corporation plant at Chalmette, Louisiana, they were faced with needing large blocks of power, at specified times, as each pot line was ready to produce aluminum. General Electric turbine-generators were selected, and two 10,000-kw and fourteen 20,000-kw units were ordered because they could be built and installed on time—ready to produce power on schedule.

Six pairs of turbine-generators will deliver 240,000 kw of power to the pot lines. Four other G-E turbines furnish power for all plant services and provide stand-by power.

ENGINEERS WORK TOGETHER

General Electric engineers worked closely with Kaiser Engineers as they do with all companies to achieve over-all project co-ordination on the installation of turbines, switchgear, transformers, rectifiers, etc.

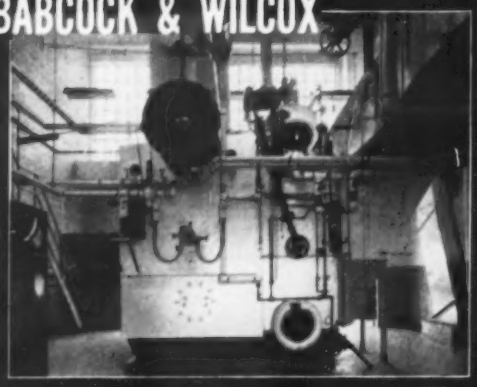
Why not call in G.E.'s experienced engineers to explain the advantages of General Electric equipment in your next turbine installation. If your plant uses quantities of steam, check the economies of G-E automatic-extraction turbines used to supply low-pressure process steam and economical by-product power. Get more for your turbine dollar with G-E turbine-generators. General Electric Co., Schenectady 5, N. Y. 256-6

You can put your confidence in—

GENERAL ELECTRIC

For more data circle 532 on Post Card

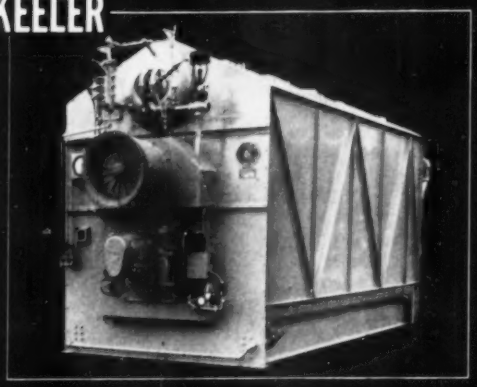
BABCOCK & WILCOX



FOSTER WHEELER

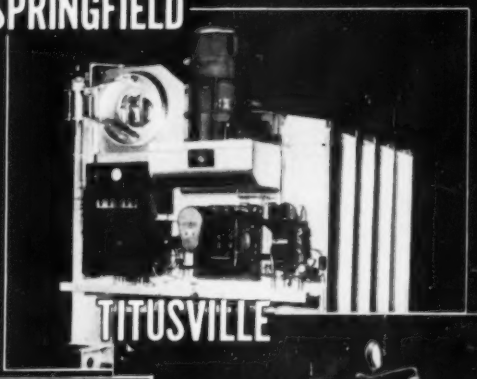
BIGELOW

KEELER

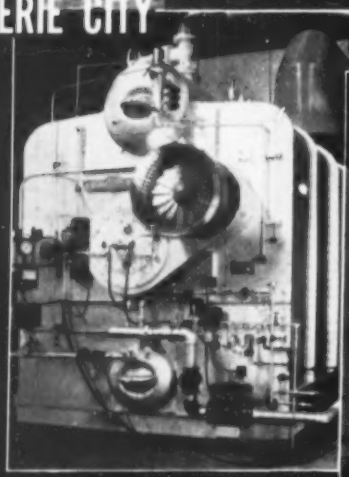


BROS

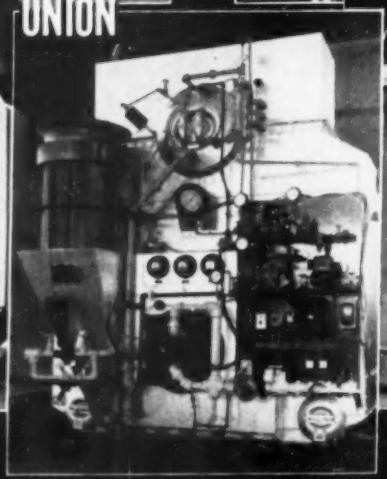
SPRINGFIELD



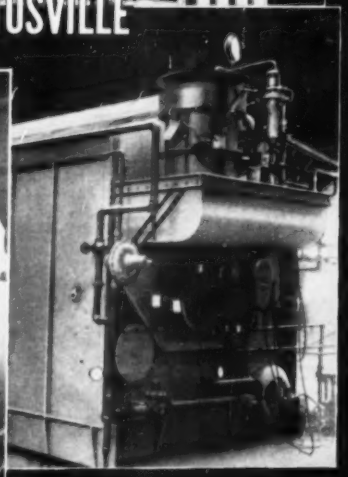
ERIE CITY



UNION



TITUSVILLE



WHY DO ALL THESE LEADING BOILER MAKERS USE WING FORCED DRAFT FOR THEIR PACKAGED UNITS?

HERE'S WHY:

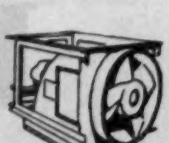
1. **Airfoil fan blading gives top efficiencies.**
2. **Wing Voltrol Vanes give 90% capacity control.**
3. **Pre-sealed bearings lubricated for their life.**
4. **Only 8 bolts required to mount blower on windbox.**

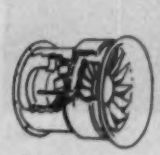
L. J. Wing Mfg. Co. 64 Vreeland Mills Road, **Linden, N. J.**

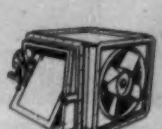
Factories: Linden, N. J. and Montreal, Can.

REVOLVING UNIT HEATERS

STRAIGHT LINE DUCT FANS

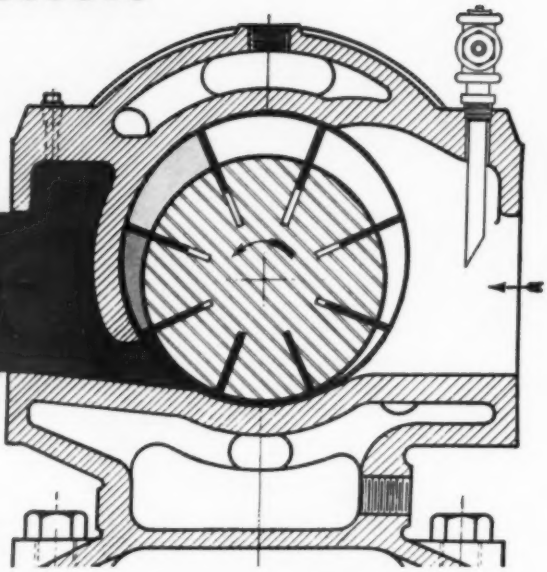

ELBOW TYPE DUCT FANS


AXIAL FLOW BLOWERS


FURNACE DRAFT INDUCERS

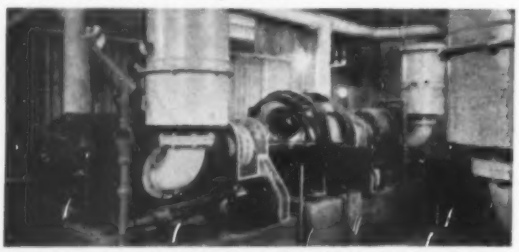
STEAM TURBINES

Fuller Rotary Compressors put the SQUEEZE on compression costs



...for pressures up to 125 lb.

Three Fuller Rotary Single-stage Compressors. Capacity each 1400 c.f.m., 19-lb. pressure.



Fuller Rotary Single-stage Duplex Compressor. Capacity 2010 c.f.m., 35-lb. pressure.

Fuller Rotary Two-stage Compressor. Capacity 1665 c.f.m., 100-lb. pressure.

When you consider all the many uses you have for compressed air, you should give careful thought to the best way to get compression with dependability, plus minimum cost and attention—selection of the proper compressor at the required pressures to do the work in the most efficient manner. Fuller builds the compressor that has ***earned*** a reputation for dependability and long life—for pressures up to 125 psig.

Fuller Rotaries have so many inherent advantages that they warrant your closest examination. Free from reciprocating parts, with no valves to leak or seats to grind, no unbalanced forces to set up vibration, they assure low-cost, smooth-flow operation during their long life. And, they give you *original, maintained capacity*.

Check your compressed-air needs . . . a Fuller engineer, specializing in compressed-air engineering, will give you the *right* recommendation to enable you to produce air efficiently, and at the lowest possible cost. Write now.

FULLER COMPANY, Catasauqua, Pa.

Branch Offices

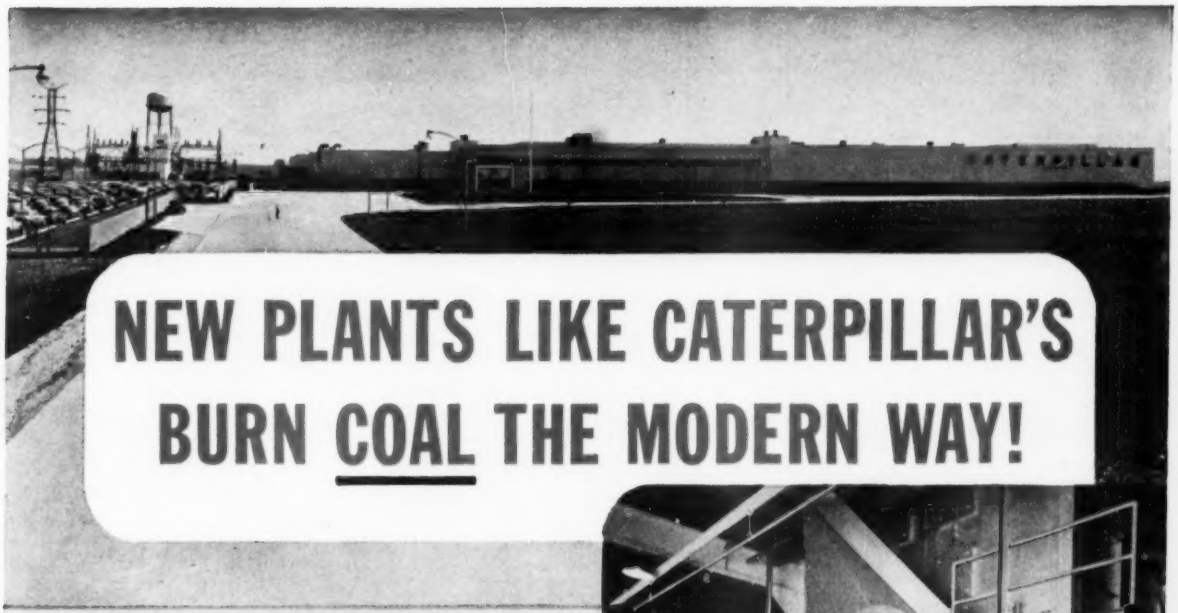
Chicago • San Francisco • Los Angeles • Seattle • Birmingham

Fuller

C-237
2157

Pioneers of high-efficiency vane-type rotary compressors

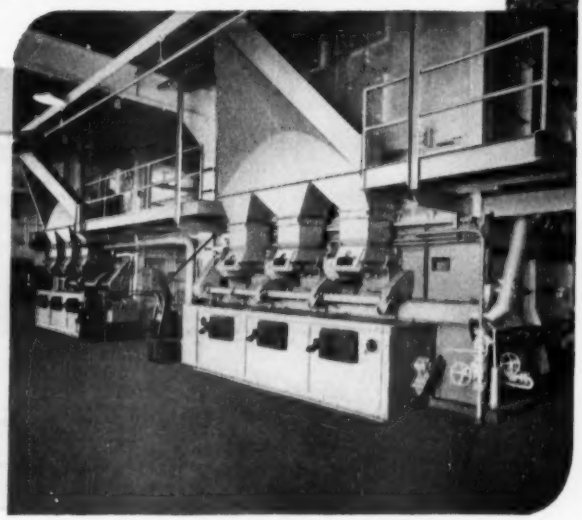
For more data circle 536 on Post Card



NEW PLANTS LIKE CATERPILLAR'S BURN COAL THE MODERN WAY!

Mr. R. H. Bachman,
Plant Maintenance Engineer,
Caterpillar Tractor Co., says:

"Our new plant pictured above was recently completed at Joliet, Illinois. A completely up-to-date coal installation was chosen to handle the heat and process steam requirements. To the right is a picture of the firing aisle showing how the boilers are fed by dust-tight chutes from overhead bunkers. This modern equipment makes coal as clean, convenient, and efficient as a fuel can be! The boilers are rated at 80,000 lbs. of steam per hour, but have handled loads as low as 3,000 lbs. per hour without difficulty."



For big savings, build for COAL! That's a good rule to follow whether you've got a new plant under construction or an older plant being modernized.

Up-to-date coal-burning equipment can give you more steam per dollar . . . modern coal- and ash-handling systems can cut labor costs to a minimum. In addition, coal is the only fuel with virtually inexhaustible reserves. And to mine this coal, to better prepare it for customers' special needs, America has the world's most productive coal industry. Thus, coal users get a double advantage—*dependable supply of an even better product, at relatively more stable prices.*

For heat, power, process steam—coal is your best bet! Ask a consulting engineer. He'll show you how to cut both fuel and operating costs by burning coal in a modern plant designed to meet your specific needs.

If you operate a steam plant, you can't afford to ignore these facts!

- COAL **in most places is today's lowest-cost fuel.**
- COAL **resources in America are adequate for all needs—*for hundreds of years to come.***
- COAL **production in the U.S.A. is highly mechanized and by far the most efficient in the world.**
- COAL **prices will therefore remain the most stable of all fuels.**
- COAL **is the safest fuel to store and use.**
- COAL **is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.**

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

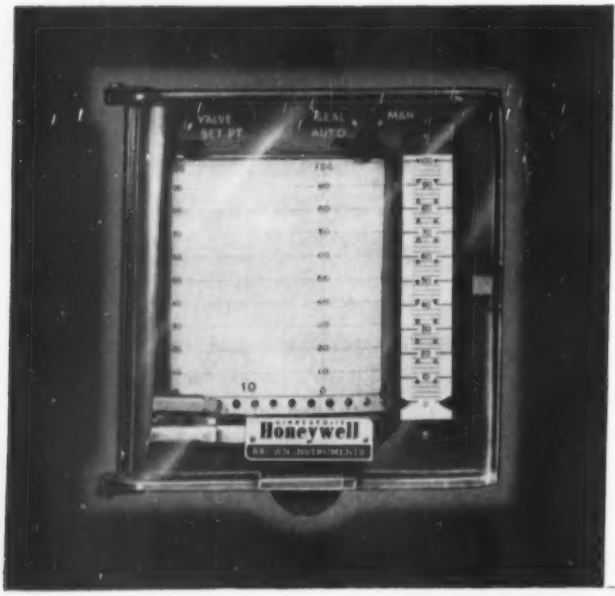
YOU CAN COUNT ON COAL!

For more data circle 537 on Post Card

FUNCTIONAL DESIGN *is the keynote of the New Murray Gill Station designed by Ebasco for Kansas Gas & Electric Co. Above is an outdoor-mounted 47,000-kw generator unit.*

ON THE BACK OF THE CONTROL PANEL *are grouped full-size instruments such as these* ***ElectroniK*** *temperature recorders. But look on the operating side . . .*

Tel-O-Set recorders on compact



Every feature you need in a miniature recorder

Tel-O-Set recorders are applicable to measurements of temperature, pressure, flow and liquid level. They embody a simple, rugged pneumatic receiving system that is actuated by low-pressure air from the remote transmitter.

The recording chart moves horizontally. A full 8-hour record is quickly available.

The panel cutout required is only five inches square. In the mounted position, the instrument can be withdrawn from its case for easy inspection and adjustment.

For more data circle 538 on Post Card

...**THE FRONT OF THE PANEL,** *only eight feet in length per unit (two units shown), where operators can watch pertinent plant variables on miniature instruments mounted directly on a functional plant diagram.*

show critical trends graphic control panels

BOILER and turbine control panels, which used to stretch for dozens of feet along the sides of a central control room, are now being compressed into small, convenient size. The key to this new technique, pioneered by Ebasco in the power industry, is graphic instrumentation . . . which displays all vital operating variables on a plant diagram. Graphic panels bring complete plant operation into sharp focus . . . improve operator's efficiency . . . speed training of new men . . . and simplify start-up and emergency control.

For displaying the many variables which need more than instantaneous indication, *Tel-O-Set* miniature recorders are ideal on graphic panels. They take no more panel space than many dial indicators. And they provide a record which reveals trends, so that operators can know which way related variables are moving, and how fast.

When you're planning graphic instrumentation, plan to utilize *Tel-O-Set* recorders for these essential "trend indicators." Your nearby Honeywell sales engineer will be glad to discuss how they can be applied to your own control panels. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* Wayne and Windrim Aves., Philadelphia 44, Pa.

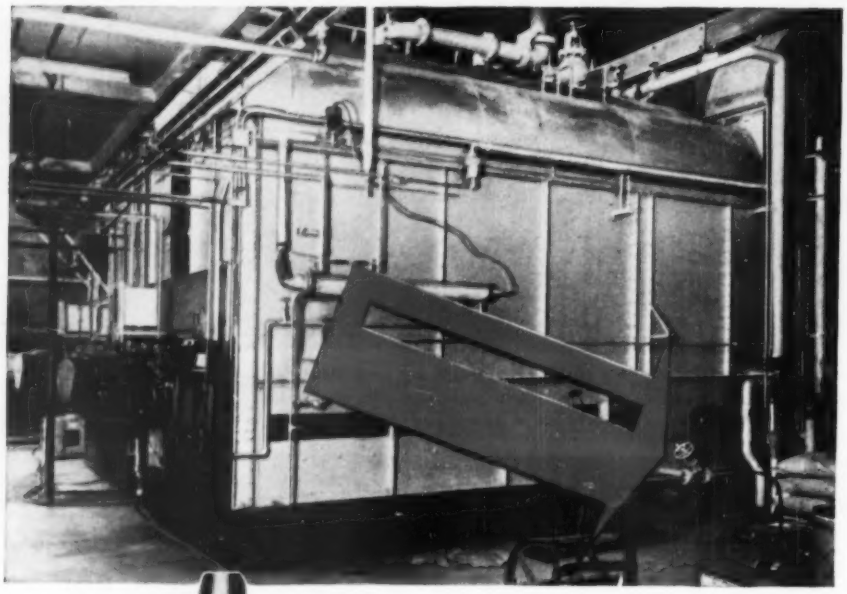
● **REFERENCE DATA:** Write for new Bulletin No. 9050, "Instrumentation for Steam Generation."

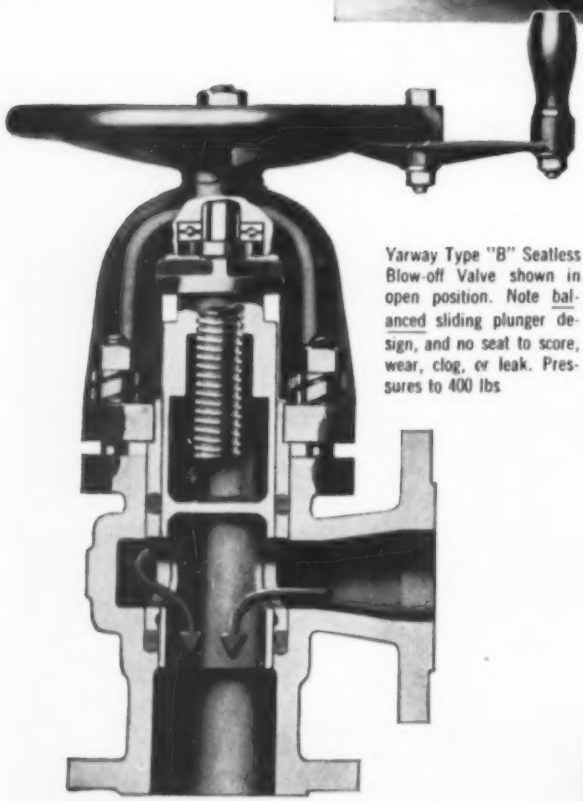
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

THIS ERIE CITY "PACKAGE" INCLUDES A YARWAY SEATLESS





Yarway Type "B" Seatless Blow-off Valve shown in open position. Note balanced sliding plunger design, and no seat to score, wear, clog, or leak. Pressures to 400 lbs.

■ The above installation of two 300 hp. Erie City VL type boilers at a Detroit automotive plant shows Yarway Seatless Blow-off Valves as part of the "package" picture.

Good package-type boilers are *better* when equipped with Yarway Blow-off Valves.

Get the advantages that have made Yarway Blow-off Valves guardians of blow-down lines in more than 15,000 boiler plants. On your package boilers—whatever the make—high grade blow-off valves pay off in dependable, trouble-free service.

Write for Yarway Bulletin B-426.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY®

SEATLESS BLOW-OFF VALVES

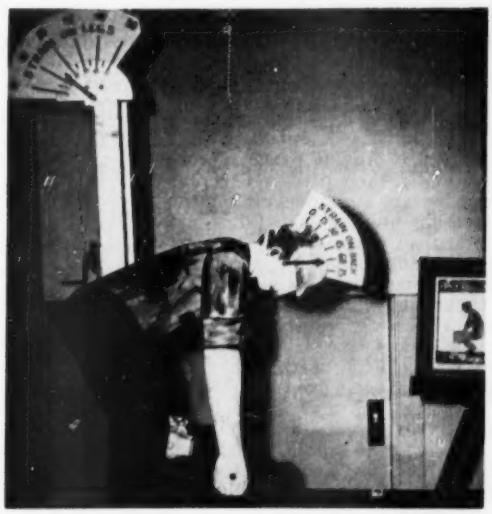
For more data circle 539 on Post Card

Lift It Right . . . . Don't Strain Yourself

This Is the Right Way to Lift

Leg muscles are stronger than back muscles for lifting, so the correct position is one that allows your legs to do the work and puts no strain on your back. In the above photo, showing right way to lift, the man's legs do nearly all the work, and his back, which is straight, takes practically no load. This distribution is shown by the model at right which shows load taken by back and legs

This Is the Wrong Way to Lift



Most back injuries and ruptures are caused, not just by weight of the load, but by trying to lift with the wrong muscles. In the above photo, showing the wrong way to lift, the man's back carries nearly all the load, while his legs have practically no strain at all on them. Model at right emphasizes this bad load distribution. (Illustrations by courtesy of The National Safety Council)

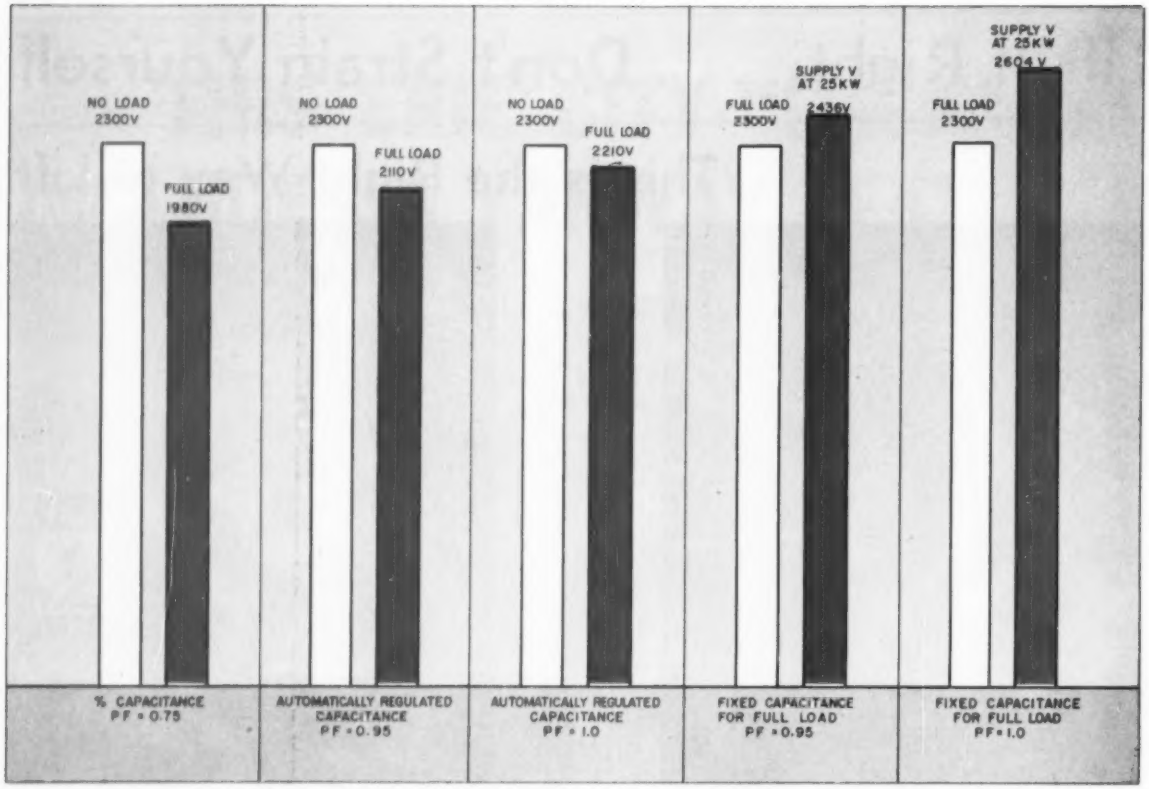


Fig. 1. Chart showing how automatically regulated capacitors improve voltage regulation. Note how the voltage rises on light loads with fixed capacitance

Automatically Regulated Capacitance

Keeping power factor constant by cutting capacitance in and out of circuit has many advantages over other methods. Here's how it works, how it is applied, and how to check its benefits for your own system

By E. H. STIVENDER*

FOR A LONG TIME public utilities have encouraged power consumers to provide power factor correction in their plants. The practice has become so important that an increasing number of utilities serving industrial areas are offering attractive inducements for consumers to install corrective apparatus. This apparatus sometimes costs the consumer a lot of money, and when he does make such investments, he naturally expects that he will be compensated within a few years. Continual improvements in capacitor dielectrics have resulted in smaller, cheaper, and more reliable units with less loss, and this further encourages the use of regulated capacitance.

In the past, power factor corrective equipment consisted of a fixed quantity of capacitance or of synchronous equipment. Now it is possible to improve operating conditions at a considerably lower cost by using a combination of fixed and automatically controlled capacitors to control the power factor automatically.

By automatically controlling the power factor, it is possible to have nearly the same voltage at each end of a distribution feeder at all times; and in some cases, the more inductive reactance there is in a line, the better the voltage regulation will be. That is, whereas the ordinary feeder is built to bring the lines as close together as possible in order to reduce reactance, the use of automatically controlled capacitance favors the lines being placed as far apart as possible, providing better insulation between lines and better voltage regulation.

In addition, there is a worth-while reduction in losses all the way back to the generating station. By placing reactors in the line, it is sometimes possible to get even better voltage regulation. In some cases, changing over to higher transmission voltage in order to accommodate increased loads can be avoided.

Equipment for automatic power factor regulation consists of control apparatus arranged to insert or remove parallel capacitance automatically, thereby maintaining a given value of power factor regardless of changes in load conditions. Because fine step regulation of capacitors might be economically impractical for most installations, no suggestion is made that this equipment replace feeder type voltage regulators universally. The equipment would, in many cases, supplement voltage regulators and, in others, serve where voltage regulators are not feasible.

Most of the voltage drop in distri-

*Consulting Engineer.
Fellow, A.I.E.E.

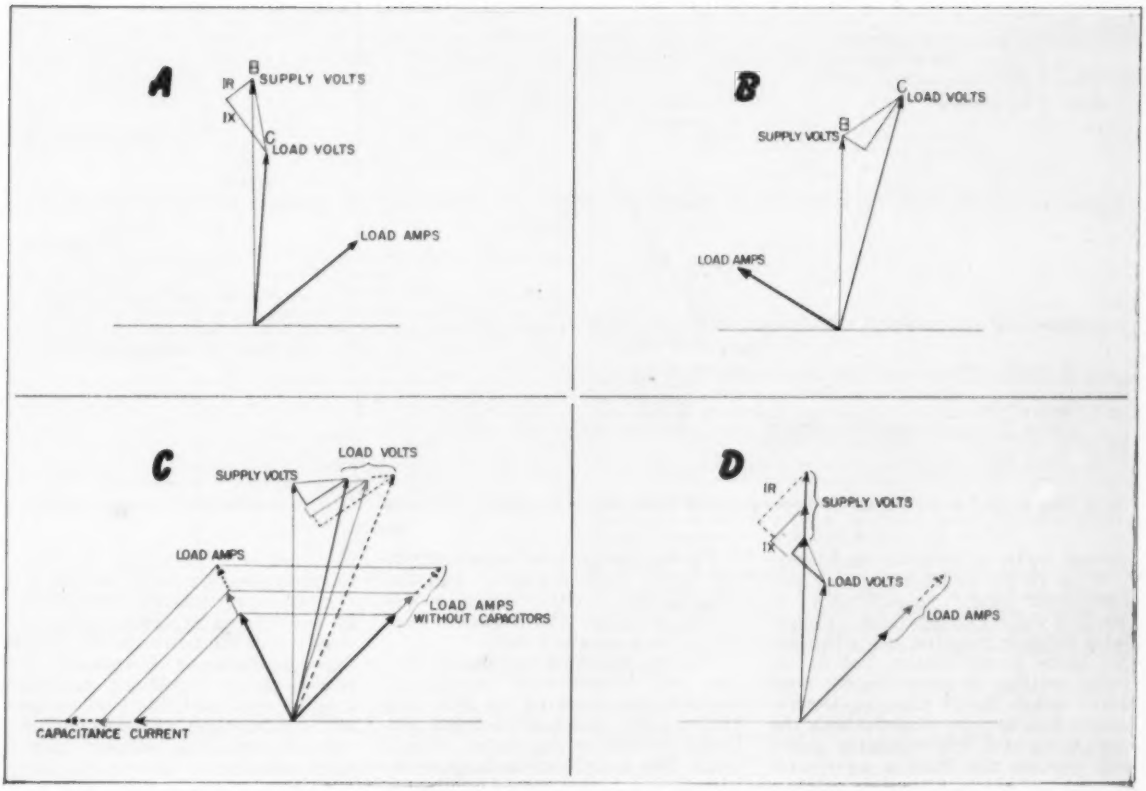


Fig. 2. Voltage Regulation. A and B. Lagging and leading current without control. C. Automatically regulated capacitance. D. Varying sending end volts

Gives You the Best Power Factor Control

bution lines is due to lagging current flowing through inductive feeders. While the feeder voltage regulator maintains constant voltage regardless of the amount of wattless current flowing, the power factor regulator can eliminate most or all of the wattless current, thereby reducing the total IZ drop of the feeder often to a small fraction.

If induction-type voltage regulators are used, the wattless component in a feeder may be considerably increased, adding more losses to the system. The power factor regulator, although admittedly not necessarily giving the same voltage regulation, reduces losses, and, as will be shown, gives desirable voltage regulation on some of the usual types of feeders supplying inductive loads.

Capacitors could be added which would permit the power factor to become increasingly leading as the kw load increases in order to provide flat voltage regulation where such operation is desired; it seems evident, however, that in practically all cases the voltage regulation resulting from maintenance of unity power factor will, in itself, be sufficient. Better regulation than this would naturally require additional capacitance, and hence would increase the cost.

With the usual fixed capacity installations for power factor correction, the entire capacitor unit is in service at all times, which results in considerable leading current flowing in the line during light loads. In many feeders, this leading current causes excessive rise in voltage at the distribution end of the line at light load periods, thus shortening the life of apparatus affected by voltages higher than normal, such as incandescent lamps and radios. Automatic regulation of the capacity connected in the circuit prevents voltage rise above normal by controlling the value of leading power factor. Heavy leading currents also contribute energy losses in distribution equipment similar to those due to lagging currents.

The diagrams in Fig. 1 show how a fixed capacitance causes the voltage to rise at light loads, and show the improved voltage regulation obtained by using automatically regulated shunt capacitance for power factor control. A simple method of calculating the voltage regulations shown in Fig. 1 is given further on in this article.

Before describing this method, let us review the fundamentals of power factor correction and voltage regulation. In the circuit shown in Fig. 2 (A) the X1 drop due to the lagging load current, at right angles to the current, and the R1 drop, in phase with the load current, combine to produce a Z1 volt which makes the load voltage less than the supply voltage by the amount BC.

If, however, the load current is leading, as shown in Fig. 2 (B) it will be seen that the same Z1 drop causes a rise in voltage so that the load volts are greater than the supply volts by the amount BC. If the power factor is adjusted to the right value and held there, the load voltage can be kept at practically the same value as the supply voltage for all values of load current. This method, which is accomplished by cutting capacitance in and out automatically as the load varies, is illustrated in Fig. 2 (C).

Figure 2 (D) illustrates the conventional method of voltage regulation in which the supply voltage is varied to maintain a constant load

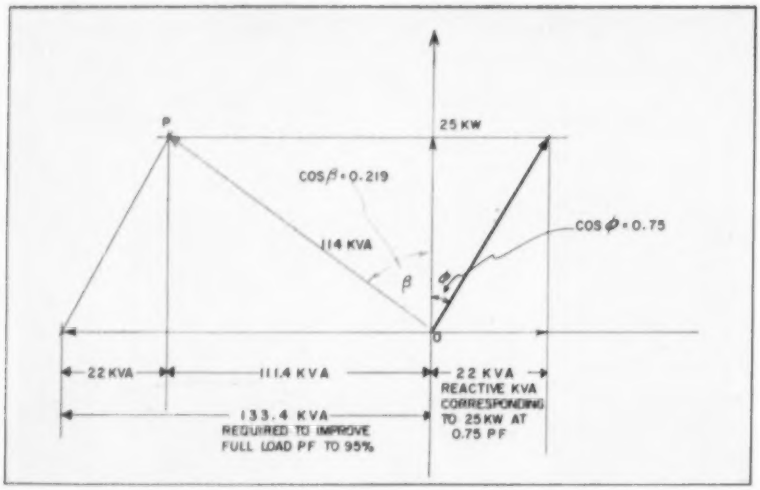


Fig. 3. Diagram for Case 4 in calculations on next page. This shows effect of unregulated capacitance

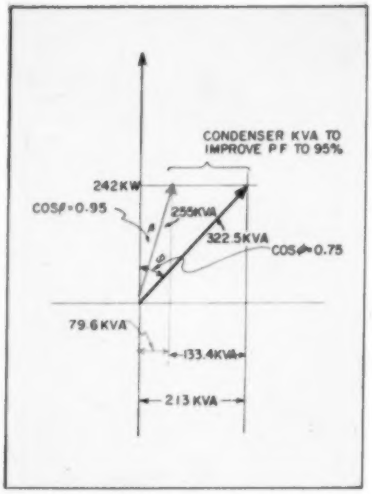


Fig. 4. Diagram for Case 2 in example on next page

voltage under all possible conditions.

It is to be understood that the equipment under consideration is not a reactive kva regulator. It regulates for zero reactive kva when set for unity power factor; but at all other settings it regulates for constant power factor allowing the reactive kva to vary directly with the kw. A reactive kva regulator would not provide the flexible service offered by the power factor regulator.

Equipment

The regulating element of a typical unit is similar to that of a contact-making voltage regulator element, solenoid operated, of rugged construction and high torque. It is not simply a contact-making power factor meter or a synchronous motor with a-c field excitation. The number of taps on the capacitors determines the smoothness of regulation. More capacity can be added as required.

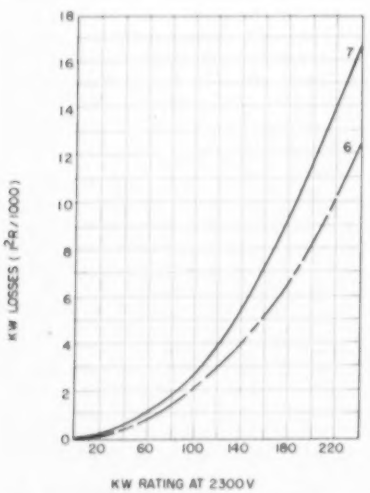


Fig. 5. Line losses compared for voltage regulation by automatically regulated capacitance (6) and regulation by varying sending end voltage (7)

The equipment is set up similar to the usual fixed capacitor installations except that the frames are designed to house the capacitor and control in a compact unit.

The tap-changing apparatus consists of oil-immersed contactors, magnetically operated for 2300 and 4000 v units, and steel-enclosed, air-break contactors for lower voltage units. The equipment is designed especially for power factor regulators, being compact and capable of standing hundreds of operations daily. On distribution feeders the requirements are generally for outdoor equipment, and provision for this can be made by housing the assembly in watertight steel cabinets.

Protection against overvoltage may be provided by an overvoltage relay set to limit to a definite amount the capacity in the circuit. Protection against short circuits may be obtained by the use of individual fuses. A main circuit breaker with overload relays would also be provided with each unit.

A control handwheel can afford manual operation. Settings for different regulated power factors are made by adjusting a knob on the regulating element. Single-phase or 3-phase regulation can be provided.

Other methods of controlling the amount of shunted capacitance include some of the magnetic amplifier circuits, locally controlled resonant "tank" circuits and electronic circuits. Since this article is a description of advantages to be gained, rather than a description of the equipment to be used, these items will not be covered at this time. It should be pointed out here, however, that a study of each installation must be made before selecting any controlling principle because of possible hazards elsewhere in the power system.

As previously stated, the capacity may be regulated in such a manner as to maintain constant voltage at the load end, as shown in Fig. 6. Furthermore, by using a line drop compensator, constant voltage may be maintained at some point other than where the power factor regulating apparatus is connected. The power factor regulating apparatus may be used with the load compensating connection, as mentioned, or a voltage regulating element may be used instead.

Methods of Voltage Regulation

Where the power factor regulating element is employed, it is usual to set the regulator for a given leading power factor, whether the voltage is to be maintained at the point of connection or at some other point. This leading power factor setting is determined by the loading conditions and line constants. By maintaining a constant leading power factor for all loads, satisfactory voltage maintenance can generally be obtained, though this method does allow the voltage to rise slightly at light loads. By using load compensation on the power factor element, the leading power factor is a function of load current and flat voltage is obtained for all loads.

The action of a voltage regulating element differs from that of the power factor regulating element in that the former tends to increase or decrease the supply voltage to hold a definite load voltage, regardless of either voltage conditions at the sending end or the wattless current in the line. This method is shown in Fig. 2 (D). A power factor regulator, however, is generally set to keep load voltage nearly equal to that at the sending end, and for this reason, line loss due to either leading or lagging current can be reduced to an absolute minimum and flat voltage maintained at the load by using some form of voltage regulation with or without load compensation at the receiving end.

This method is adaptable in cases where voltage regulating equipment

is in use at a generating or distribution point; then power factor regulating equipment with or without load compensation is beneficial at the receiving points.

If power factor regulation is considered before a distribution line is constructed, by spacing the conductors on the poles farther apart than is normal, greater inductive reactance can be obtained, and hence less capacity is needed for the regulating equipment.

While ordinarily the conductors

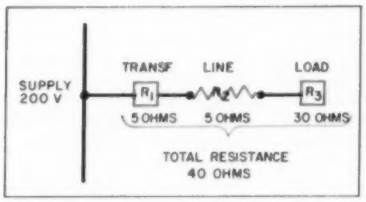
continued on page 108

Simple Way to Figure Regulation of Your System With and Without Capacitors

This method is approximate, but it is accurate enough for the purpose. First, here is a simple analogy to explain the method:

Figure 6 shows a simple d-c circuit. R_1, a resistance of 5 ohms, corresponds to a distribution transformer, R_2, a resistance of 5 ohms, corresponds to a distribution feeder, and R_3, a resistance of 30 ohms, corresponds to a distribution load. Therefore the total resistance in circuit is 40 ohms.

Fig. 6



With a supply voltage of 200,

Load current is $\frac{200}{40} = 5$ amps

Load Voltage = Load Amps × Load Resistance
= 5 × 30
= 150 volts

Therefore voltage regulation is $\frac{200 - 150}{200} = 0.25$ or 25%

This simple method is applied in the examples that follow, using the correct a-c values of resistance, reactance and impedance.

Case 1. System With No Regulating Equipment

Assume that the equipment in Fig. 6 has the following characteristics:
Supply: 13,800 volts single phase
Transformer: 400 kva, ratio 13,800/2300 Impedance (Z_t) = 0.54 ohms
Resistance (R_t) = 0.23 ohms
Reactance (X_t) = 0.40 ohms
(pri. & sec.)

Feeder: Impedance (Z_f) 2.58 ohms
Resistance (R_f) 0.65 ohms
Reactance (X_f) 2.50 ohms
Load. 2300 volt equipment rated at 242 kw, 75% power factor
Putting this in terms of impedance:—

242 kw at 75% pf $= \frac{242}{.75} = 322.5$ kva $= \frac{E^2}{Z_L}$ where E = 2300 volts, Z_L = load impedance

i.e. $322.5 = \frac{2300^2}{Z_L}$

so $Z_L = \frac{2300^2}{322.5} = 16.4$ ohms

At 0.75 power factor, Cosine $\phi = 0.75$
From tables, ϕ is 41.4 deg and Sine ϕ is 0.6613
Therefore R_L which is 16.4 × Cos ϕ = 16.4 × .75 = 12.3 ohms
And X_L, which is 16.4 Sine ϕ = 16.4 × 0.6613 = 10.7 ohms
Adding the three impedances together, i.e., Z_t, Z_f, and Z_L
Total impedance = 13.18 + j13.6 ohms
In these calculations the symbol j is used to denote $\sqrt{-1}$

At 2300 volts, with this impedance, the load current is $\frac{2300}{(13.18 + j13.6)}$ amps

To solve this equation multiply top and bottom lines by (13.18 − j13.6)

The equation then becomes $\frac{2300 \quad (13.18 - j13.6)}{(13.18 + j13.6)(13.18 - j13.6)}$

$= \frac{30300 - j31300}{358.5} = 84.5 - j87.3$

$I^2 = 84.5^2 + 87.3^2$
I = 120 amp
Voltage V at this load will be I × Z_L
I = 84.5 − j87.3 amp
Z_L = 12.3 + j10.7 ohms
So V = (84.5 − j87.3) (12.3 + j10.7)
= 1972 − j167 volts
$V^2 = 1972^2 + 167^2$
V = 1980 volts

Voltage Regulation $= \frac{23000 - 1809}{2300} = 13.9\%$

Case 2. With Automatic Regulation for Minimum Power Factor of 95%

Now assume an automatic power factor regulator to be installed at the load in the circuit of Fig. 6 to give 95% pf at full load.
Referring to Fig. 4, the reactive kva for 242 kw at 75% pf is 322.5 Sin ϕ
Sin ϕ is 0.6613, so the reactive kva is 322.5 × 0.6613 = 213 kva

Full load kva corresponding to 242 kw at 95% pf $= \frac{242}{.95} = 255$ kva

Angle β, from tables = 18.2 deg
Reactive kva at 95% pf is 255 × Sin 18.2 = 255 × 0.3123 = 79.6 kva
Therefore condenser kva to improve pf from 75% to 95%
is 213 − 79.6 = 133.4 kva
To find the voltage regulation with this power factor improvement, determine the impedance, resistance and reactance for 242 kw at 95% power factor by following the same method explained in detail for the first example, then, since the transformer and feeder impedances, resistances, and reactances are unchanged, obtain full load current and load voltage as detailed in the first example.
The full load current will be 101.2 amp
The load voltage will be 2110 volts

The voltage regulation will be $\frac{2300 - 2110}{2300} = 8.25\%$

Case 3. With Automatic Regulation for 100% Power Factor at All Loads

From the two previous examples it will be seen that the condenser capacity needed to improve the power factor to unity is 213 kva
Applying the same method, the results are as follows:
Full load current 100.8 amp
Load voltage 2210 volts
Regulation 3.9%

Case 4. With Fixed Capacity But No Automatic Regulation, Minimum 95% Power Factor

Assume that the circuit in Fig. 6 has a fixed capacity connected to the load which will improve the full load power factor to 95%. Assume the minimum load is 25 kw at 75% power factor, such as an industrial plant with a few lights burning at night with some small fans and pumps running, or just an office building with lights and fans.
Referring to Fig. 3, it will be seen that 25 kw at 75% pf has 22 lagging reactive kva.
This is subtracted from condenser kva of 133.4 kva to give a leading reactive kva of 111.4 which corresponds to a total kva of 114 at a power factor of 21.9% leading.
Applying the method already detailed in the previous examples:
Load Impedance is 46.4 ohms
Load Resistance is 10.2 ohms
Load Impedance is 45.4 ohms
Transformer and feeder characteristics are the same, so applying the previous method:
Load Voltage will be 2436, i.e., there will be a rise in voltage at the receiving end of 136 volts, or about 5.9%, which in many cases will be enough to discourage the use of fixed capacitors. Obviously the only way to get good power factor at the load safely and economically is to use variable capacitance, automatically regulated.
When there is no load at all on the feeder, the voltage will reach an even higher value than the one shown here.

Case 5. With Fixed Capacity and No Automatic Regulation, Minimum of 100% Power Factor

Using method of the previous example, it will be seen that with a load of 25 kw at 75% pf, the load voltage would rise to 2604 volts, which is a rise of 13.2%.
At this point the circuit is near resonance, the no load losses would be greater than those at full load, and the fixed condensers would be undesirable even if the voltage rise could be tolerated.
The results of the five cases considered here are summarized in Fig. 1.

Does Your Plant Make Too Much noise

In future articles we will describe latest methods of locating, measuring, and reducing objectionable industrial noise. To help you understand these methods, here are some fundamentals of acoustics that every engineer, as a perpetrator and a victim of noise, should know

By G. L. BONVALLET *

AIR IS AN ELASTIC medium, and a vibrating body, or pulses of air, steam, or gas, produce compressions and rarefactions which are transmitted through the air on account of its elasticity. These impulses, when they strike the human ear, are interpreted as sound or noise by the brain.

Air movements caused by sound waves are extremely small — for the noise of an old street car at 50 ft a particle oscillates from its rest position by only 0.00005 in. The frequency of a sound wave is the number of times a second compression and rarefaction occurs. If the noise causes 500 compressions and rarefactions a second, then the frequency is said to be 500 cycles per sec.

It is not easy to define the difference between sound and noise since the same sound may please one person and not another. Music to one person may be unpleasant noise to another, and even a pleasant tone will turn into a noise if played loudly enough. However, there is a fair amount of agreement about what constitutes an industrial noise and whether or not it is objectionable.

Generally speaking, musical instruments produce wave motions of several frequencies, all of which bear some simple relationship to each other. Noise, on the other hand, usually consists of wave motions in the air (or sensations in the ear) which are unrelated in frequency and time. Noises such as the clatter of a punch press, the hiss of an air ejector, and the impact of one member on another consist of random frequencies of a transient nature.

For present purposes, industrial noises may be broadly classified as (a) steady-state noises in which discrete tones stand out, (b) steady-state noises in which no discrete tones predominate, and (c) transient noises. Transient noises are those which are not steady. They may vary in pitch or frequency or in loudness, or they may be intermittent. Automobile horns, sirens, some high speed compressors, and many pitched vibration devices can be placed in the first group. Internal combustion engines, ball mills, heavy complex mechanical equipment, pneumatic concrete-breaking drills, etc., are typical of machines that provide relatively unpitched steady-state noises. Most of the noise in these can be identified as having few or no pitched tones. Typical machines which produce a transient type noise are drop-forging hammers, slow punch presses, metal cutting shears, and other machines that make short-lived noises with short rise times. When such transient noises are repeated at a rate of about one cycle per second or slower, they become quite difficult to measure accurately. These different groups will be of importance later in analyzing noise.

A machine emitting noise has many surfaces or radiating areas which produce unpleasant sound as mentioned above. The radiating surfaces may be sheet or cast metal housing, gears, or other small or large areas. The radiating areas are more significant the larger they are. In order to make an intense noise, either a large area may be vibrated with small amplitude or a small area may be vibrated with extremely high am-

*Associate Physicist, Acoustics and Vibrations Section, Armour Research Foundation of Illinois Institute of Technology.

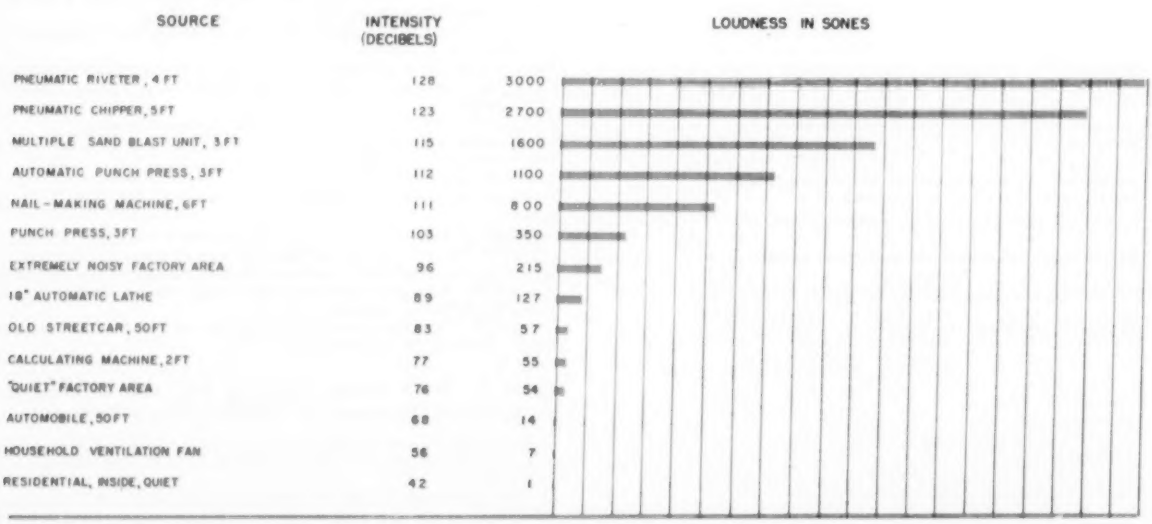

SOURCE
INTENSITY (DECIBELS)
LOUDNESS IN SONES
PNEUMATIC RIVETER, 4 FT 128 3000
PNEUMATIC CHIPPER, 5FT 123 2700
MULTIPLE SAND BLAST UNIT, 3 FT 115 1600
AUTOMATIC PUNCH PRESS, 3FT 112 1100
NAIL-MAKING MACHINE, 6FT 111 800
PUNCH PRESS, 3FT 103 350
EXTREMELY NOISY FACTORY AREA 96 215
18" AUTOMATIC LATHE 89 127
OLD STREETCAR, 50FT 83 57
CALCULATING MACHINE, 2FT 77 55
"QUIET" FACTORY AREA 76 54
AUTOMOBILE, 50FT 68 14
HOUSEHOLD VENTILATION FAN 56 7
RESIDENTIAL, INSIDE, QUIET 42 1

Fig. 1. Loudness of typical industrial noises. Judgments made by the ear agree more closely with the loudnesses in sones than with the sound levels in decibels

plitude. The energy source in each case is usually a member which is driving the radiating surface.

A simple illustration of a radiating surface separated from its source is the violin. The vibrating string, after it has been bowed or plucked, is the source. Vibrational energy is transmitted through the bridge to the body of the instrument, and the body does the radiating. If the body were removed or greatly reduced in area, the instrument would not sound nearly as loud, since there would be no large surface to couple the vibrations to the air.

It is not within the scope of this outline to describe the physiology of hearing, but here are a few details about the human ear that will help readers understand some of the difficulties of noise measurement and prevention.

Audible frequencies vary, for average people with normal hearing, from about 15 to 15,000 cycles per sec. The ear constitutes a sensitive sound analyzer and as sounds are heard, the brain sorts them out into high, medium, or low frequencies with all intermediate gradations. The two ears also constitute a sensitive system for efficiently locating a sound source.

Many physical properties of sound are measured by the ear, which also measures the loudness of sounds. One of the most difficult goals of acoustical scientists is to devise a meter that will agree with the ear in these measurements. This goal is difficult because the loudness of sounds interpreted by the ear does not have a direct relationship to the intensity measured by a meter in decibels at the various frequencies.

Figure 3 illustrates this variation of loudness with frequency. Each curve represents a single loudness level judged by the ear. It will be seen that the loudness in the high frequency bands is much greater than at low frequencies, and this is confirmed in practice by innumerable examples. The high notes of a piano can be heard above all the instruments of the orchestra playing together; a small instrument like a violin can be heard as easily as the much larger double bass, and a policeman uses a whistle instead of a lower pitched instrument because the whistle's high frequency enables him to make a penetrating noise with a small expenditure of energy.

Each curve in Fig. 3 represents a single loudness level judged by the ear. The loudness in these curves is shown in phons. The phon is a unit of loudness which was used in the past for many purposes but is now being replaced by the sone, an easier unit to handle, about which we will say more later.

Figure 3 shows that an intensity or pressure level of 50 decibels produces a loudness of 50 phons at 1000 cps, but at 10,000 cps a pressure level of 63 decibels is needed to give the same loudness, while at 30 cps a pressure level of 83 decibels is needed to give

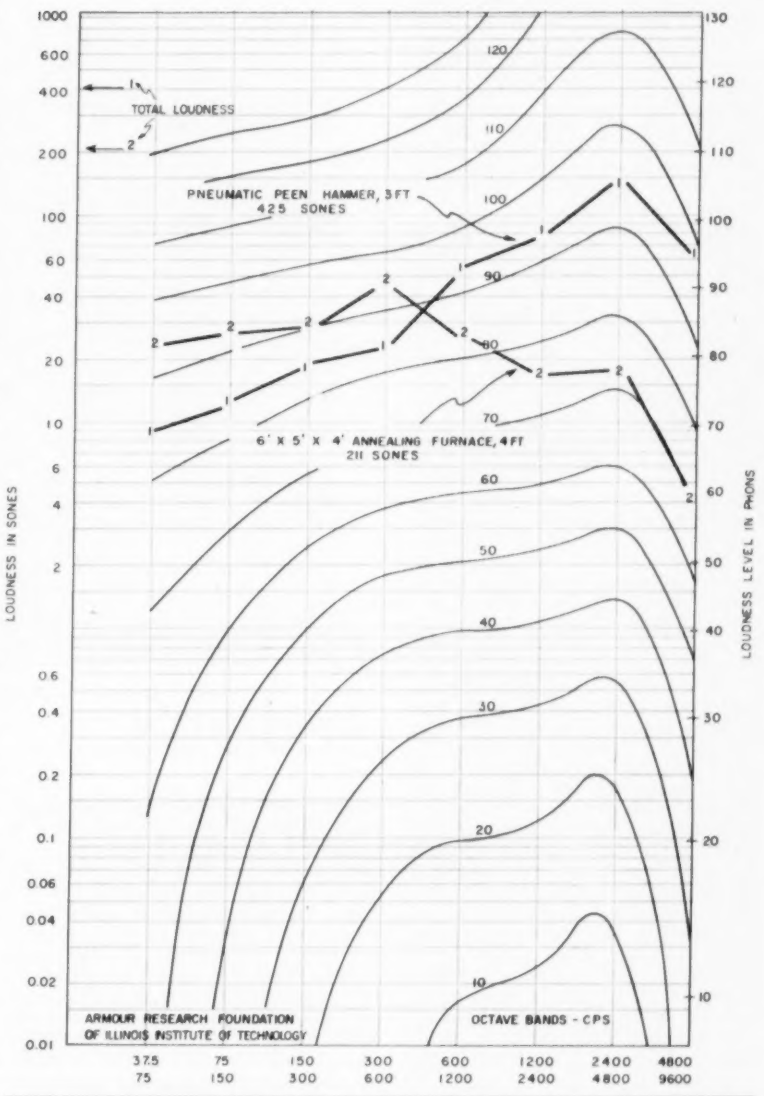

LOUDNESS IN SONES
LOUDNESS LEVEL IN PHONS
TOTAL LOUDNESS
PNEUMATIC PEEN HAMMER, 3FT
425 SONES
6' X 5' X 4' ANNEALING FURNACE, 4FT
211 SONES
ARMOUR RESEARCH FOUNDATION
OF ILLINOIS INSTITUTE OF TECHNOLOGY
OCTAVE BANDS - CPS
37.5 75 150 300 600 1200 2400 4800
75 150 300 600 1200 2400 4800 9600

Fig. 2. A chart for calculating loudness. The thin lines show curves of constant intensity in decibels. Points for constructing the curve for the annealing furnace were obtained from the octave band levels in Fig. 4

the same loudness. It will be seen from the chart that other loudness levels vary with frequency in a similar manner.

The unit of loudness level, the phon, suffered from the disadvantage of being a logarithmic unit. Loudness as interpreted by the ear is not conveniently related to the loudness level in phons. With the sone, a more satisfactory unit which is being increasingly used in acoustical work, loudness interpreted by the ear is more easily related to the number of sones. The sone is an arithmetic unit, such that, for the technique described, a loudness of 200 sones is twice as loud as one of 100 sones. With phons, on the other hand, a loudness of 100 phons would not have a simple relationship to a loudness of 50 phons.

To give an idea of the range of noise in sones, one sone is about as loud as the inside of a quiet residence, which is about the loudness of a 1000 cps tone at an intensity of 40 decibels. Figure 1 shows the intensity levels in decibels and the loudness in sones for a number of typical industrial and city noises.

Since a noise consists of a number of sounds of different frequencies, and since the ear, when it hears this noise, sorts out the sounds at the different frequencies, an instrument for measuring loudness must attempt to do the same thing. To make an instrument as delicate as the human ear, so that it could measure every frequency of which a noise is comprised, would be very difficult and expensive. In practice a compromise is made by measuring sound pressure levels for a series of fairly narrow

frequency bands and computing loudness from these. These bands cover the whole audible frequency range, and a typical commercial instrument would measure in the following frequency bands: — 37.5–75; 75–150; 150–300; 300–600; 600–1200; 1200–2400; 2400–4800; 4800–9600 cps. These measurements are obtained easily on the filter set by pushing buttons or turning a step switch.

For most industrial noise problems, the octave band data, as it is called, yields sufficient information about the noise. Here is how the data is applied to get loudness figures.

Figure 4 shows the octave band readings for the noise made by an industrial annealing furnace. When these readings have been taken they are plotted on the chart shown in Fig. 2. This chart has been designed by Armour Research Foundation to facilitate analysis of noise problems. The vertical scale shows loudness in sones; the horizontal scale shows octave bands for different frequencies. On this gridwork of lines are drawn curves corresponding to equal sound pressure levels for the different frequency bands. Thus, a level of 70 decibels in the 150–300 cps band corresponds to a loudness of 6 sones; the same noise in the 600–1200 cps band has a loudness of 10 sones, and the same noise in the 2400–4800 cps band has a loudness of 15 sones.

The two curves of data shown in Fig. 2 emphasize the value of the loudness figures over the overall levels. It can be seen that the loudnesses of 425 sones for the pneumatic hammer and 211 sones for the annealing furnace are in the ratio of two to one. These loudness values confirm the ear evaluation that one is about twice as loud as the other. When it is realized that both noises had overall levels of 102 decibels, the value of the loudness figure is better appreciated.

In most industries the sound measured near a single machine is the noise of that machine combined with the background noise. For most purposes it is desirable to measure the total noise since it is this condition to which personnel are exposed.

In practice, nearly all noises are made up of complex vibrations having many frequencies. If each frequency has the same amount of energy put into it, the high frequencies will make the loudest noises, so when we want to remove objectionable noises, the first things to look for are the high frequency vibrations.

In subsequent issues we will show how these principles are applied by acoustical engineers when diagnosing noise troubles. The method will be illustrated by showing how it was applied to an actual power plant which had received complaints of excessive noise. Then we will show how noise is actually reduced or eliminated in practice once it is known where it is coming from and how much it must be reduced.

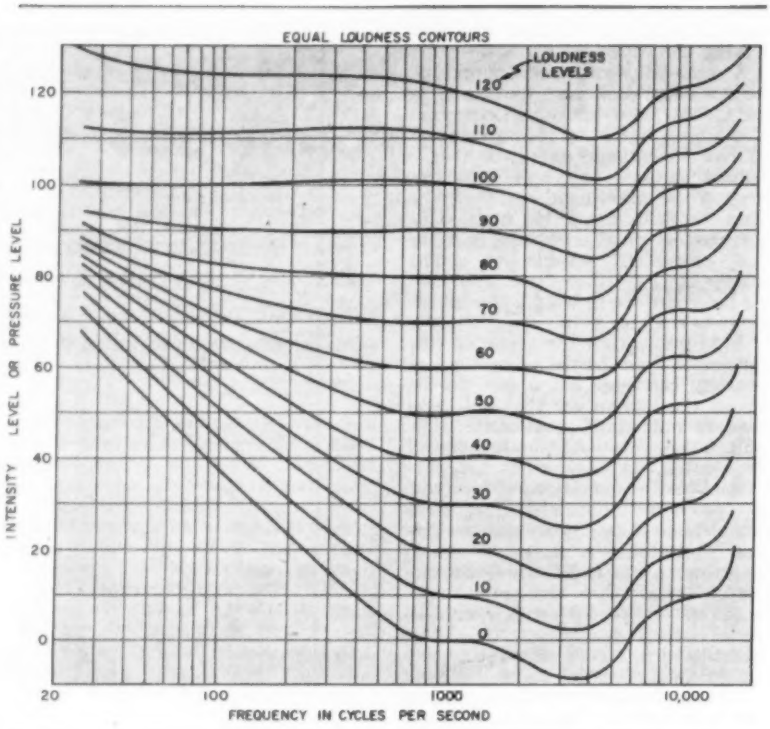


Fig. 3. Fletcher-Munson equal loudness contours show variation of loudness with frequency for pure tones

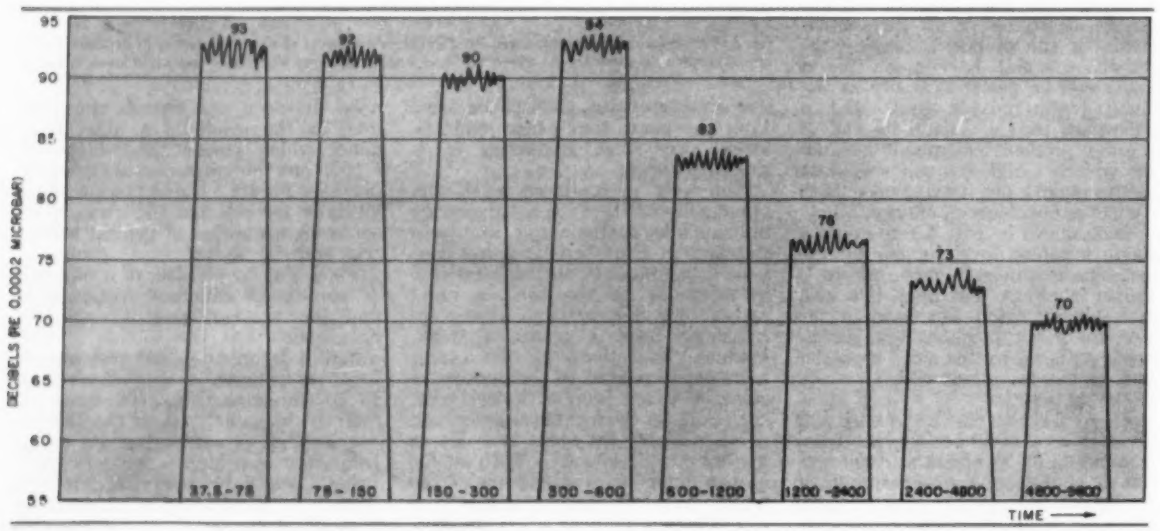


Fig. 4. Octave band readings for an industrial annealing furnace. These octave band levels are then plotted on the chart in Fig. 2 to obtain total loudness

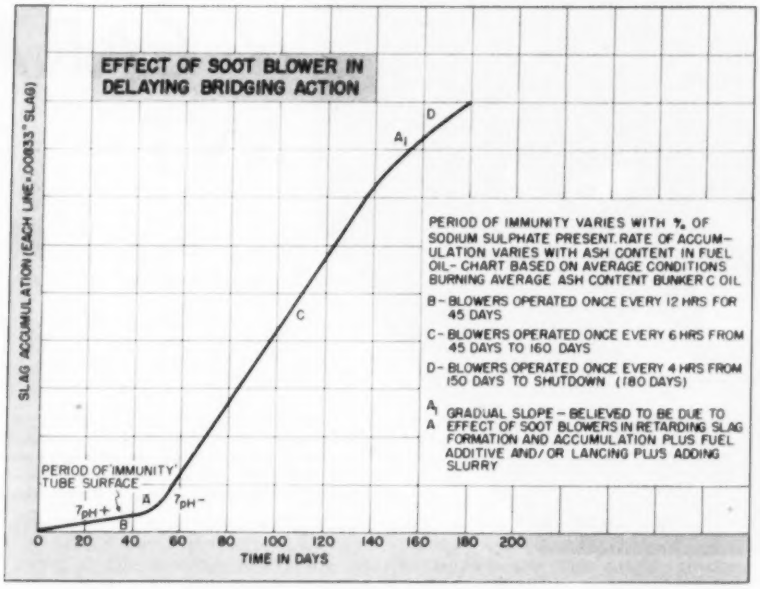

EFFECT OF SOOT BLOWER IN DELAYING BRIDGING ACTION
SLAG ACCUMULATION (EACH LINE=.00833" SLAG)
PERIOD OF IMMUNITY VARIES WITH % OF SODIUM SULPHATE PRESENT. RATE OF ACCUMULATION VARIES WITH ASH CONTENT IN FUEL OIL- CHART BASED ON AVERAGE CONDITIONS BURNING AVERAGE ASH CONTENT BUNKER C OIL
B- BLOWERS OPERATED ONCE EVERY 12 HRS FOR 45 DAYS
C- BLOWERS OPERATED ONCE EVERY 6 HRS FROM 45 DAYS TO 160 DAYS
D- BLOWERS OPERATED ONCE EVERY 4 HRS FROM 150 DAYS TO SHUTDOWN (180 DAYS)
A1 A GRADUAL SLOPE - BELIEVED TO BE DUE TO EFFECT OF SOOT BLOWERS IN RETARDING SLAG FORMATION AND ACCUMULATION PLUS FUEL ADDITIVE AND/OR LANCING PLUS ADDING SLURRY
PERIOD OF IMMUNITY TUBE SURFACE
TpH+
TpH-
A
B
C
D
A1
0 20 40 60 80 100 120 140 160 180 200
TIME IN DAYS

Chart shows how slag can be limited by frequent blowing in early stages when accumulation is small

Slag-Blowing Pointers

IN SPITE OF improved boiler design, slag formation and removal is still a difficult problem due to the use of fuel oils containing higher concentrations of residual. These oils leave hard deposits which are more tenacious and difficult to remove than slag deposited during coal burning.

Troublesome oils have an ash content ranging from 0.03 to 0.25 by weight, and the ash is high in compounds of sodium, vanadium, iron and nickel. Sulphuric anhydride and sodium oxide are known to be present in large quantities.

Of fifty central stations included in a recent survey, consensus was that slag accumulation rate and density varied directly with ash content of the oil, but that initial accumulation varied proportionally with the percentage of sodium sulphate present, the sodium sulphate being formed by sulphuric anhydride and sodium oxide, or sodium chloride and sulphur in the process of combustion. This is believed to be due to the bonding of the oxides of sodium, vanadium, and iron with sodium sulphate to form a water insoluble and acid reacting slag. Adhesion to the tube is also apparently dependent on the percentage of sodium sulphate present.

Powdered fuel additives, used in a 1 to 1 ratio with the ash content of the oil, while making the job of slag removal easier, doubled the residuals entering the boiler. This magnified the problem of slag disposal after it had been removed from the tube surface, especially on oil fired boilers without provision for slag removal.

These remarks, and the following discussion, based on a survey of a number of boilers operating at pressures over 600 psi, were given in ASME Paper No. 53-SA-66, presented by John A. Vanyo, Special Engineer, and S. F. Walleze, Field Engineer, both of Copes-Vulcan Division of Continental Foundry & Machine Co., in Los Angeles in July 1953.

Slag Reducing Methods

Here are some of the methods of reducing slag formation that were attempted, with comments on their effectiveness.

1. Filtering Oil to Remove Ash: — Though this method has been neither proved nor disproved, most operating groups have discounted the idea on the grounds that the percentage of ash dissolved in the oil is high and can not be filtered out.

2. Centrifuging: — Another theory is that the residual can be removed from the oil by centrifuging. To do this the oil has to be preheated to 200F before centrifuging, and then cooled for storage. It is doubtful whether this method would be economically sound because of the high initial investment, the heating and cooling of the oil which must take place with resultant heat loss, and the low percentage of residuals that can be removed.

3. Painting boiler tubes: — Painting tubes with a lime slurry or similar preparation and adding a high pH solution in an attempt to keep the surfaces of the tubes alkaline has had some good results. It has been shown through tests by one operating company that slag formation does not start until the tube surface becomes acid, and the rate of initial accumulation can be delayed for some time by the frequent addition of a high pH solution while on the line.

4. Fuel Additives: — These were used with varying degrees of success. Most successful ones have been fully reported in a paper at annual ASME meeting, New York, Dec. 1952.

5. Mechanical methods: — Another popular method is the use of supplementary hand-lancing, either combined with water washing through the soot blowers or using the soot blowers themselves. Occasionally the combination of hand-lancing, plus a fuel additive and soot blowing may be found.

In selecting a blowing medium for a retractable type of slag blower, we would first like to clear up a few misconceptions.

First, tubes are just as likely to be cut by air as by steam. It is not the blowing medium that does the cutting, other than extremely high velocity water, but rather the abrasive entrained fly ash.

Second is the fallacy that air cleans better than steam. This may be true for certain types of deposits, but in general cleaning ability is directly proportional to the energy in the jet from the nozzle as it strikes the deposit. The question of time, as well as quantity and velocity of jet must always be considered. It stands to reason that a difficult deposit cannot be removed merely by the fleeting application of a high kinetic energy. It may take several seconds or a longer application of the same energy at one spot to remove a given deposit. Therefore the speed at which the cleaning jets are rotated across the face of the slag will affect cleaning results. Time plus available energy is the important combination.

The time-slag chart below shows how rapidly slag builds up after a slow initial period, and this emphasizes the importance of frequent blowing. Years of successful experience show that the problem is simplified if the cleaning units are operated so frequently that the initial accumulation is prevented. This may require blowing as often as one operation per blower per hour. However, there can be no compromise if a clean boiler is to be the goal.

Though modern boiler designs have reduced the slagging problem, fuels of even lower quality will probably be burned in future and the problem of slagging will tend to be a continually recurring one. Close cooperation between boiler companies, operating companies, and accessory manufacturers will be needed if trouble is to be minimized, or prevented entirely.

SARA

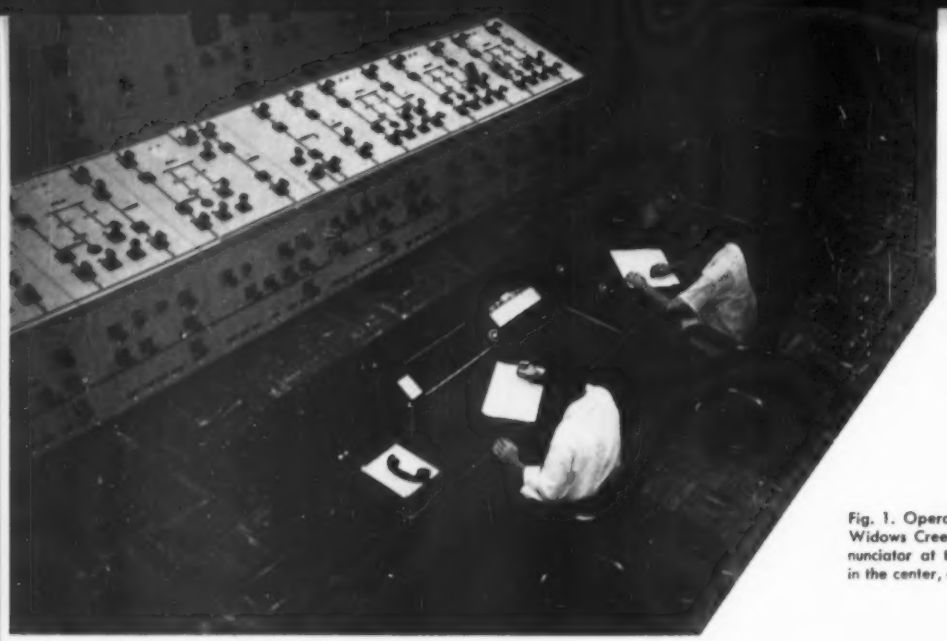


Fig. 1. Operators' desks in the main control room at Widows Creek Steam Plant with the 64-window annunciator at the left, manual telephone switchboard in the center, and automatic printing recorder at right

SARA, whose full name is sequential automatic recording annunciator, is a new member of a family of automatic recorders employed on super highways and toll bridges to count traffic and record toll receipts. Considerable modifications were required to adapt the recorder system for central station use. The Authority has installed this new type of station operation recording system at its new Johnsonville, Widows Creek, and Shawnee Steam Plants.

Sara is more versatile than other members of the family. Her job combines the duties of a telephone operator, complaint clerk, and secretary for the central control room operators. She is on duty 24 hours a day to receive messages from approximately 400 alarm stations and oil circuit-breakers located throughout the powerhouse, switchyard, and control building. She can memorize 25 rapidly occurring trouble conditions or switching operations in one-third second and print these signals at a more leisurely rate of one printing every three seconds. Even though the signals may occur only split seconds apart (approximately 0.014 sec) they are all recorded in their proper sequence as indicated by the "sequential" in Sara's long name.

Sara's Brain Structure

Sara's brain fills a steel cabinet 12 ft long by 2 ft deep by 7½ ft high located in the communication room in the basement of the control building, and includes over 400 relays, 20 selector switches, 300 capacitors, and many other components. Her nervous system of electrical conductors extends throughout the plant to contacts of circuit-breaker auxiliary switches, float switches, protective relays, high temperature alarms, pressure switches, and similar alarm devices. Her typewriter (or printer) and the 64-window annunciator are recessed in the operator's desk of the main control room, Fig. 1.

The block diagram, Fig. 2, shows the principal components of the sequential automatic recording annunciator system.

How Sara Monitors Trouble

A multiple contact, plug-in, telephone-type relay is provided for each trouble contact. When a trouble relay is energized its contacts perform three functions. If the trouble condition requires annunciation, a circuit is completed to 1 of 64 annunciator windows. Other contacts route charging impulses to a bank of 10 capacitors, which retain an identifying binary code number until such time as the printer can print the trouble condition. Another contact feeds an impulse to the memory selector to select an unfilled memory bank for the next incoming signal. As many as 26 separate coded signals can be fed to the memory section in approximately one-third second. All trouble relays are identical and interchangeable, with the individual coding determined by the wiring between the relay contacts and the memory capacitor banks.

By resorting to the binary system of counting, widely used in computers, it is possible to represent any code number between 0 and 512 with only 9 digits or 9 capacitors in each memory bank. This system employs counting units in the form of the powers of two, namely: 1, 2, 4, 8, 16, 32, 64, 128, and 256. Any number up to 511 can be obtained by selecting and adding different combinations of these 9 digits. This reduces the total number of capacitors required to slightly more than ⅓ of the number required for a corresponding memory system based on the conventional decimal system. Since the alarm systems installed at the three TVA steam plants require only 400 separate signals, the equipment is further simplified by using only the code numbers that can be represented by combining not more than six binary digits out of the nine

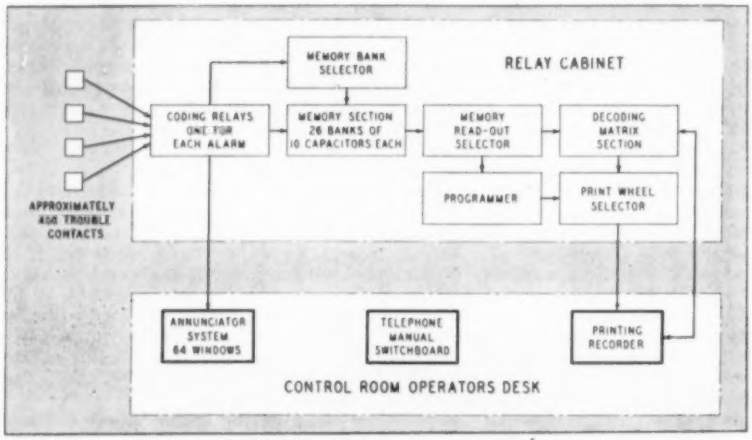


Fig. 2. Diagram of sequential automatic recording annunciator. Each alarm signal is coded, stored, read-out, decoded, recorded in proper sequence

Keeps Watch at Three TVA Steam Plants

Electrical monitoring and recording system maintains 24-hour-a-day watch on several hundred pieces of apparatus in TVA's steam plants

By R. M. ALSPAUGH*

available. This reduces the number of contacts required on the coding (or trouble) relays.

The tenth capacitor of each bank is used to distinguish between the occurrence of a trouble condition and the return to normal. Form D contacts of the trouble relays are so connected that the same code is stored in the memory bank when the trouble relay resets as was stored when the relay picked up except for this tenth capacitor, which receives no charge when the relay resets.

Sara Has Good Memory, Too

The memory bank selector consists of a 26-position rotary stepping switch, controlled by a thyratron tube. Operation of any trouble relay will trigger the thyratron and advance the stepping switch one step to select a new uncharged bank of capacitors for the next incoming signal. Interrupter contacts on the stepping switch extinguish the thyratron during each stepping operation. In the event of rapidly occurring alarms the entire memory section of 26 separate capacitor banks can be filled in approximately one-third second.

As soon as the memory selector switch has advanced one or more steps, a similar switch used for the memory read-out selector starts to scan the charged banks of capacitors at a relatively slow rate corresponding to the printing cycle. As each memory bank is scanned, the charged capacitors are discharged through grids of thyratron tubes which control the "flip-flop" relays of the decoding matrix section, Fig. 4. The circuit through the two matrices are determined by the combination of charged capacitors in each memory bank, or the original stored codes. Only four thyratrons and corresponding relays of the first matrix are required to start any one of 16 print-wheel selector switches, and the second matrix of five thyratrons and five relays stops the selected stepping switch on one of its 25 positions. The heavy-line circuit of the upper matrix of Fig. 4 shows how the discharge of condenser with binary code numbers S2 and S8 will fire the corresponding thyratron tubes to set up a circuit between B+ and print-wheel selector switch No. 10. In a like manner, the firing of tubes P4 and P8 in the lower matrix will complete a circuit to position No. 12. Thus this particular code will advance print-wheel selector switch No. 10 to the No. 12 position.

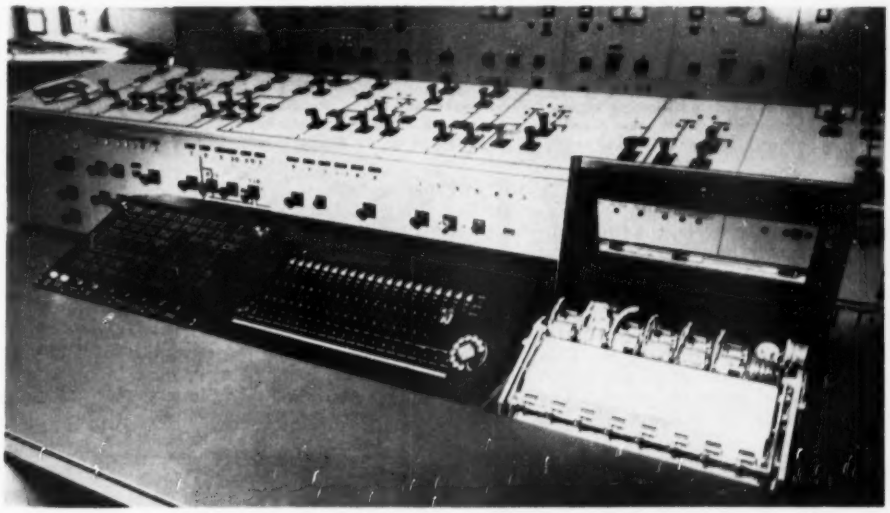


Fig. 3. Desk equipment with hinged cover of the recorder raised. Print wheels are at top of unit. The entire unit is hinged to facilitate inspection, maintenance, chart replacement

Finally Sara Prints It

The rotary print-selector switches have ten levels, eight of which are used to control heavy-duty, 30-position, stepping switches in the printer, which drive the printing drums. The individual printer switches and corresponding printing drums are stopped at positions corresponding to the printing of the desired signal.

Thus an alarm signal initiated for example by an oil level switch on power transformer No. 3 will cause the illumination of an annunciator window engraved "Transformer Low Oil Level," but in addition the signal is coded, stored (or memorized), read-out, decoded, and printed on a wide strip chart as "Transformer No. 3 Oil Level Low." The printing will also include the date and time to the nearest second. When the condition is corrected, the printer will print "Transformer No. 3 Oil Level Normal" with the date and time.

The programmer provides a posi-

* Principal Electrical Engineer, Division of Design Tennessee Valley Authority, Knoxville, Tenn.

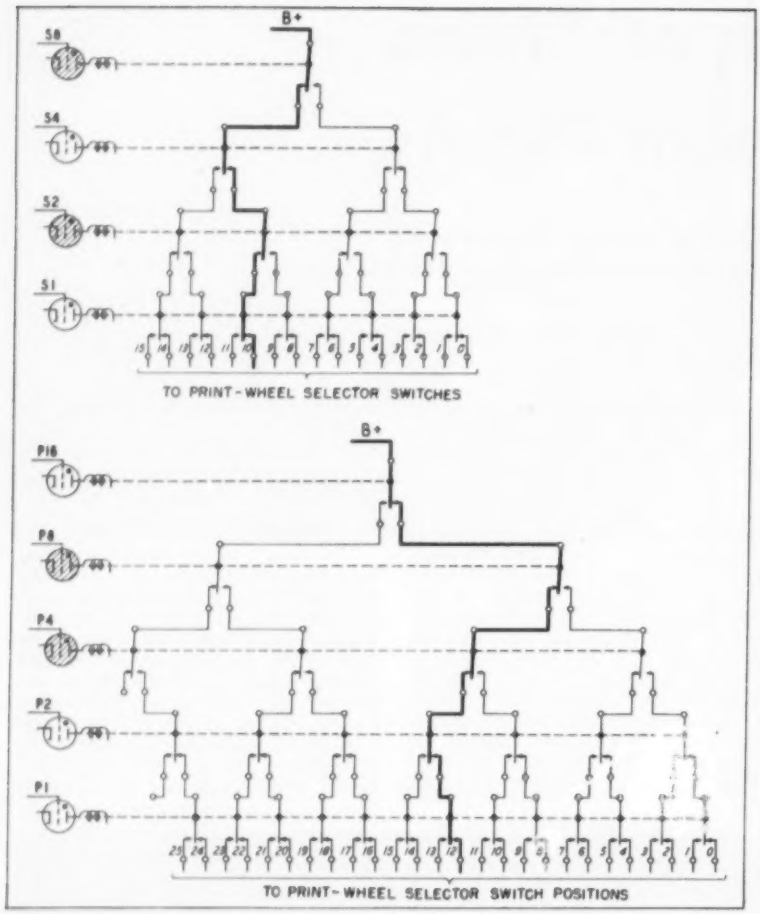


Fig. 4. Diagram of the decoding matrix section. During memory read-out the thyratron tubes at the left are triggered in accordance with codes stored in capacitor banks. Firing of thyratron tubes S2, S4, P4, and P8 will advance print-wheel selector switch No. 10 to position No. 12. Full explanation in the text

tive means of sequentially operating the various selection cycles. Following each printing cycle, the programmer restores the thyratrons and resets the print-wheel selector switches. Then the sequential memory read-out selector advances to the next charged memory bank and starts another printing cycle. This operation continues until all stored signals have been recorded. The chart is not driven continuously, but is advanced with each printing. A portion of the chart with the last six recordings is visible through the recorder window, or by lifting the window, the operator may examine the entire chart.

Why Sara Is Needed

The Authority has long recognized the need for some form of recorder to supplement the station annunciator system. During a major system disturbance or an emergency shutdown of a generating unit, the control-room operators are often too busy trying to restore service to keep an accurate log of all relay and switching operations. The automatic printer provides a permanent record of what happened, how long a generator or line was out of service, and when service was restored. These records along with charts from automatic oscillographs are invaluable aids in determining the cause of the trouble and in planning corrective measures to guard against its recurrence.

At some of the smaller hydro plants and at a few of the substations, the operation recorders consist of one or more 20-pen recorders. The solenoid-operated pens are controlled by alarm contacts or auxiliary switches of the oil circuit breakers. Standard recorder charts have the pen numbers from 1 to 20 printed across the chart at regular intervals. Special charts can be obtained, however, with the actual alarms printed on the chart instead of the pen numbers.

During construction of the Chickamauga hydro plant in 1939, the Authority worked with a manufacturer of a fire-alarm recording system to develop a suitable station operation recorder. The small fire-alarm recorder, normally used for recording the code number of outlying fire-alarm stations, was modified and expanded to print a great variety of central station alarms. The Authority has sixteen of these recorders in service, two of which record trouble conditions occurring at remotely controlled hydro stations. In installations for remote stations, the signals are stored and coded at the remote stations, then transmitted via telephone cable or power-line carrier equipment to the operation recorders at the dispatching stations.

Sara is a newcomer in the field of central-station operation recorders. In civil service parlance, she is still on probation as she has been employed less than a year at three of the Authority's steam plants. However, she gives every indication of being able to meet the qualification for obtaining a permanent employee status.

When Is Single-Phase Motor Cheaper?

ALTHOUGH three-phase motors, of 3 to 10 hp such as used for air conditioning and pumping purposes, can be used where only single-phase power is available with phase converters, the ordinary single-phase motor is preferable on an economic basis, it was reported at the Winter General Meeting of the AIEE.

"Analysis shows that the three-phase motor with converter on single-phase supply has a considerably lower breakdown torque than the motor alone supplied with balanced three-phase power," A. Habermann, Jr., of GE, said in a paper entitled Single-Phase Operation of a Three-Phase Motor With a Simple Static Phase Converter. This and other performance features . . . suggest that, after all, the ordinary single-phase motor is preferable on an economic basis.

This study has indicated, Mr. Habermann said, that the simple phase converter cannot produce completely-balanced terminal voltages at full load, so there must be a derating of the three-phase motor when operated in such a way. If this were not done, one would be operating the motor in a manner that experience has indicated would shorten its life and would not provide the satisfactory margin for over-loads and line voltage variation. Ability to carry only normal load does not provide satisfaction. In addition to the factors of relative cost between the three-phase motor and single-phase motor, there are many practical factors to be considered, such as convenience to the manufacturers who ship equipment with three-phase motors installed.

What "Explosion-Proof" Really Means

Most engineers know that totally enclosed electrical equipment is not explosion-proof, but many do not realize explosion-proof equipment is not totally enclosed. Here is a simple explanation

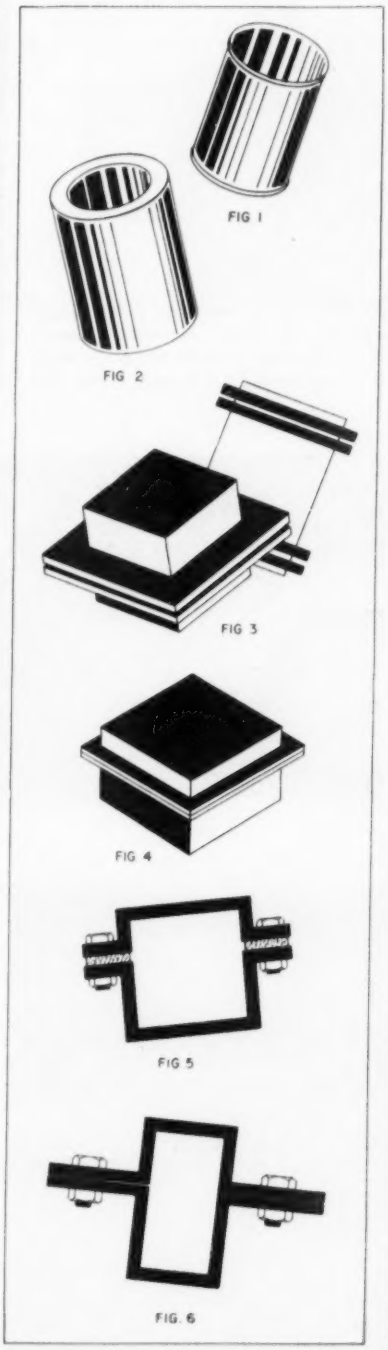
GOOD EXAMPLE of total enclosure is the can of oil shown in Fig 1. The can keeps the oil in and the air out; but it would not be strong enough to contain the oil if it exploded.

To make the can explosion-proof, and at the same time keep it sealed, we could make it out of thick steel, as shown in Fig. 2; strong enough to resist an internal explosion, and with the joints sealed by welding. This would be an example of a totally enclosed explosion-proof housing, though it would be useless, as the oil would be inaccessible once the can had been sealed.

For the same reason it is impracticable to weld all the joints of electrical equipment enclosures. We need to open tranformer tanks, switch housings, junction boxes and other enclosures shown in Fig. 3 to get at the apparatus inside; so nearly all electrical equipment housings have some kind of bolted flanges.

Consider the junction box shown in Fig. 4. We want to make it explosion-proof, so that an explosion inside will not shatter the box, and so that hot gases caused by the explosion cannot escape into the surrounding inflammable atmosphere and cause a general explosion. Both lid and box are made of thick ribbed steel, and the lid is held down by more than the normal number of bolts so there is no danger of it being blown off. The problem is how to seal the lid. If we put a gasket between lid and box, as shown in Fig. 5, it will be blown out when an explosion occurs, and the hot gases will escape into the inflammable atmosphere and cause an explosion. If we do without a gasket and tighten the lid without any packing, the hot gases will still get out and cause an explosion, because it is not practicable to make ordinary metal flanges fit well enough to exclude all gas or vapor.

In practice, no attempt is made to seal the flanges. They are ground smooth enough to limit the gap between them to .002 in., and they are made very wide; i.e. the flange length in Fig. 6 is made longer than is necessary for mechanical strength. When an explosion occurs inside the box, hot gases escape by passing between the flanges. They cool as they pass through this narrow slit, which is of such length that by the time the gases get out of the box, they are too cool to ignite the surrounding atmosphere. Every inflammable atmosphere has to be raised to a certain temperature before it can be ignited (the particular temperature depends on the kind of atmosphere) and as long as the hot gas coming out of the box is below the ignition temperature of the surrounding atmosphere there will be no explosion. Explosion-proof equipment is specified for particular groups of gases because the flange design, among other things, depends on the temperature at which each group ignites. For a highly inflammable group the flange will be very wide; for a less inflammable one it will be narrower.



These diagrams illustrate explanation in the text

If the surrounding atmosphere is corrosive, as well as explosive, so that it would damage the equipment if it got inside the enclosure, some method of keeping it out must be used, such as piping fresh air into the housing and keeping it under higher pressure than the surrounding atmosphere. The explosion-proof housing will not keep out the corrosive gas by itself.

We have used a junction box to illustrate this peculiarity of explosion-proof enclosures, but the same applies to any equipment with this kind of housing. It is not totally enclosed, and gas can get in and out of it. It will get out if there is an explosion within the housing; it will also pass in and out with the breathing effect which takes place as any electrical apparatus heats and cools during normal operation. We do not attempt to stop the flow of gas; all we do is make sure that if it does cause an explosion, no harm will be done outside the housing.

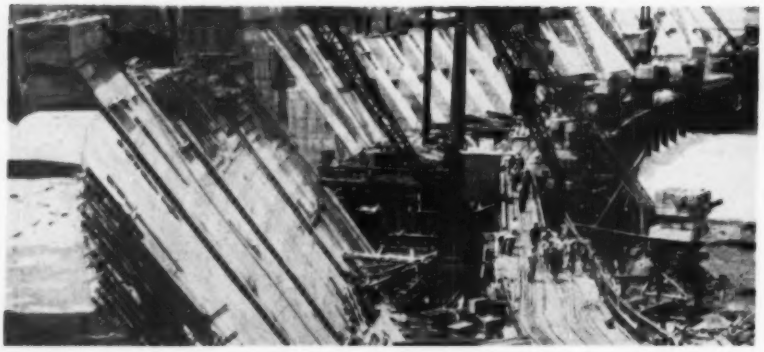
It is important to realize that when deciding whether or not a particular piece of equipment needs an explosion-proof housing, we are concerned with worst conditions rather than normal operation. For example, a d-c motor, with sparking brushes, operating in an inflammable atmosphere, must obviously be protected, but it is easy to forget that an ordinary three-phase induction motor is just as dangerous. When it is operating normally it produces no spark or flame, but, should a fault occur in the winding while it is operating in an inflammable atmosphere, then an explosion can be produced.

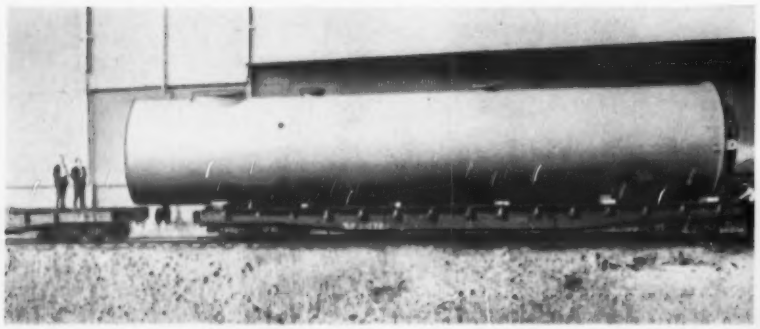
Confusion is also caused when equipment operates in an atmosphere that changes its concentration. Such an atmosphere may be perfectly safe 99 per cent of the time, being either too concentrated or too weak to be explosive; but, if at any time while it is concentrating or diffusing, it passes through a stage during which it is inflammable, then it needs explosion-proof enclosure. Explosion-proof enclosures are like fire engines: you don't need them often, but when you do you need them badly.

Power Engineering's NEWS REEL

A 22 mev betatron is "loaded" with a single film measuring 40 x 120 in., which is sandwiched between fiber board and 16-ga. steel. Beam is rotated over full length of the film

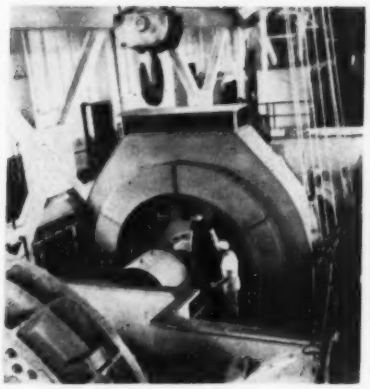
Five times the capacity of Boulder Dam will be stored behind this dam across the Nile at Lake Victoria's outlet. It will provide irrigation and 150,000 kw





A 74 x 12-ft silencer to subdue exhaust noise of a 5000-kw gas turbine generating unit was shipped by Burgess-Manning to a midwestern utility

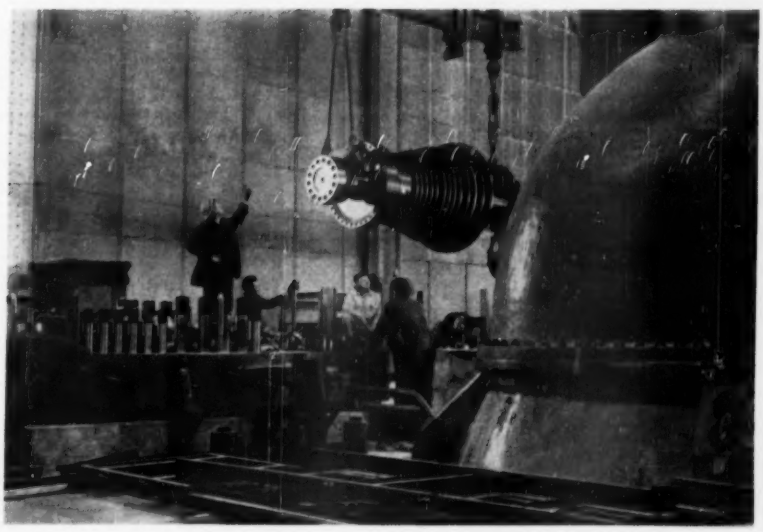
Pumped mercury rectifier converts 5000 kw a-c from 25,000 v to 600 v d-c for finishing stand motors of new hot strip mill at Pittsburgh Steel's Allenport Works. Two units are used



This 8000-hp wound-rotor motor, largest ever used on a dredge, drives a single-suction centrifugal pump aboard the *Hydro-Quebec* on the Beauharnois Canal. It receives its power by a 4000-ft submarine cable from shore

Discharge pile along Beauharnois Canal between Lake St. Frances and Lake St. Louis, Quebec. Boulders weighing 1500 lb and 28 in. in diameter are pumped through 36-in. line

The *Hydro-Quebec*, world's largest pipeline dredge, is being used to clear entire 3300-ft width of 15-mile long Beauharnois Canal to a depth of 35 ft. Deepened canal will help expand Beauharnois powerhouse to more than two million horsepower, largest single-site hydro plant in the world. Canal will be unit of St. Lawrence Seaway. The dredge is powered by GE electrical equipment



Intermediate pressure spindle of A-C's close-coupled cross-compound turbine is lowered into place in a midwestern utility. Unit is rated at 120,000 kw, with high and intermediate pressure sections operating at 1000 F and 3600 rpm. Low pressure section is double flow and operates at 1800 rpm. Close-coupling is new arrangement suitable for ratings to 500,000 kw. Compactness permitted setting entire unit on single foundation

Pointers on the Conservation of Fuel, Heat and Energy

Excerpts from the report of a team of British technical specialists after a visit to the United States to compare British and American industrial practices and make recommendations for a nation wide program to conserve fuel and promote improved utilization of resources

COAL IS THE basis of industrial life in Britain and for all practical purposes, is the country's only indigenous source of energy but coal is a diminishing asset; therefore, it is immensely important that it be used to the best purpose.

In the United States, industry at large has a higher level of efficiency in the utilization of fuel and power than prevails in Britain and it was in this sphere that the team's particular investigations were made and we believe beneficial comparisons drawn.

In the production or application of heat and power, American industrial practices are parallel with those of Britain but the outstanding difference is that American industry is quicker to adopt new ideas and follows a bolder course in the scrapping of inefficient equipment.

It has been said that high productivity is coincident with economy of fuel. The team had not appreciated the real significance of this truth until it had made a series of visits to American factories and seen it exemplified. It was particularly impressed by the receptive attitude of the worker to new ideas as a means of improving his lot in life. Indeed the ambition to achieve a better standard of living permeates the whole fabric of life in the United States. It is in this atmosphere that high productivity is obtained and flourishes.

The economies of steam and power production are perhaps better understood and their values better appreciated in the US than in the UK. Most college trained American engineers are particularly well versed in the subject.

There was however no evidence of any universal method of costing and different firms have developed different methods to suit their own requirements. Indeed in some the costing system was deliberately designed more to regulate the departmental use of steam and power than to establish the proper allocation of charges. In other words it was arranged to penalize extravagant use.

Of steam and power costing it may be said that any system however simple or incomplete is better than none as it does show up the effect of any change in fuel or plant operation or any change in factory process.

A well devised costing system also enables a target to be established in terms of unit cost. For example, pounds of fuel per barrel of beer or kilowatt hours of electrical energy per unit of production whatever this may be. Such targets are of the greatest value in the operation toward development of an industrial plant and particularly for comparing the performance of one factory with another.

In many industrial plants the wastage of water, steam and electricity and other service supplies such as gas and compressed air adds up to something formidable in terms of fuel required to provide them. The full appreciation of this loss leads to the conclusion that the major economies in fuel are, in fact, more likely to be achieved in the factory than in the boilerhouse.

This fundamental relationship of energy consumption to output is illustrated in Fig. 1. This is based upon conditions attained in a large British industrial plant. The dotted line running diagonally upward from left to right represents the established relationship between output of the finished product and the steam consumption per week.

The crosshatched areas in the bottom lefthand corner show that the total steam consumption is made up of two quantities, a fixed steam load independent of output and covering radiation losses and warming up requirements of the plant, equipment and buildings to normal working temperatures, and second: a variable steam load directly dependent upon the output.

Assuming that the normal weekly output of the plant is 6,000 t of finished product requiring 30 million pounds of steam, the full line running diagonally downward from left to right shows the relationship between steam consumption per unit of output and an increase or decrease in production.

Thus a 50 per cent decrease in out-

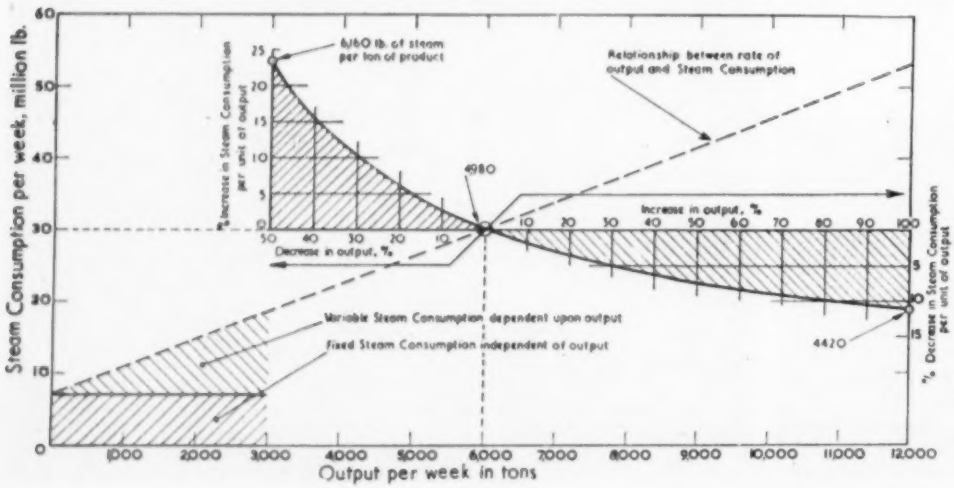

Steam Consumption per week, million lb.
Output per week in tons
6,160 lb. of steam per ton of product
Relationship between rate of output and Steam Consumption
4980
4420
Decrease in output, %
Increase in output, %
% Decrease in Steam Consumption per unit of output
Variable Steam Consumption dependent upon output
Fixed Steam Consumption independent of output

Fig. 1. Steam consumption data for a large British industrial plant arranged to show the effect of increased productivity on steam requirements per unit of product. Note the proportion of steam load that is fixed and independent of plant capacity and the proportion that varies directly as factory output. Cutting plant capacity from 100 to 50 per cent increases the unit steam consumption 12.5 per cent while a further cut to 25 per cent capacity increases the steam requirement per unit of product nearly 40 per cent

Members of the Fuel Specialist Team while on the trip were entertained in Chicago by the Editors of Power Engineering and Chicago power engineers

put increases the steam consumption per unit of output by 23 per cent while a 50 per cent increase in output decreases the steam consumption per unit of output by 7½ per cent. This diagram illustrates the enormous importance of increased productivity as a means of saving fuel.

Instrumentation and the use of automatic boiler control had been developed to a much greater extent in the US than in the UK mainly because of the urge to reduce labor costs. Every one of the 47 boiler plants inspected by us was reasonably well instrumented and fitted with some kind of automatic control. In the public utility power generating stations and the larger industrial plants visited, remarkably few operatives were in evidence compared with British practice, the whole installation being controlled by pushbutton.

In British industrial plants it is a common practice to install a considerable amount of standby steam in power generating equipment ranging from 20 to 30 per cent in the larger plants and as much as 100 per cent in the smaller plants.

In contradiction there is a marked tendency in the US to dispense with standby plans over and above maximum demand as represented by peak load winter conditions and to rely on preventive maintenance and the summer period for major overhaul of the individual boiler.

The probable difference in point of view in this connection in the two countries is that in the US boiler and power plant units are large and it is therefore difficult to justify the heavy cost of providing standby. In the UK they are usually relatively small so the cost is less significant. Another important factor is that in the US the heating load in winter is heavy and therefore during the summer months, the boiler plant can be layed off for inspection and overhaul.

One disadvantage of installing too much standby plant is that the design of the boilerhouse and power station is thereby more or less crystalized for many years ahead. Advantage cannot be taken early enough of any new developments in steam raising such as topping pressure and the generation of power. This may well explain why in the US too much standby is frowned upon.

In the UK the mechanical handling of coal and ash in small boiler plants is the exception rather than the rule whereas in the US the reverse is true. A wide choice in mechanical equipment is available there and is installed on even small plants burning only a few tons of fuel a week. Less labor is required and attendants have more time to devote to efficient operation and proper maintenance. The elimination of dust and dirt from the boilerhouse boosts morale and attracts a better and more intelligent class of labor.

The team was interested to note the broad similarity in equipment for, and practices of, boiler water treatment in the US and the UK. In the US there are marked differences in certain directions namely: a, wider treatment of after treatment in the boiler drum or shell; b, more general employment of fully automatic softening equipment; and c, greater respect for the need to maintain correct and more constant conditions at all times.

There is a general appreciation that no system of feed water conditioning can be more effective than its control and great attention is therefore focused on this aspect of the subject.

Much of the harm done in an industrial plant by allowing heavy steam peaks to develop could be avoided if work was properly scheduled and large consumers were brought into operation in sequence instead of simultaneously particularly at the beginning of each shift.

Although too much freedom is given to factory operators to open and close steam valves without regard to the effect this may have on the productive efficiency and fuel economy, a greater degree of control and a better understanding of all the implications would most definitely improve productivity in every sense of the term.

In the majority of sizable industrial plants in the US the Chief Engineer is an executive official of standing. He has a good education and specialized training and has at his disposal assistants who are almost equally well qualified and are obvious as it were in the "line of succession."

Personnel

Team spirit thus inspired is impressive and engenders justifiable pride in the achievement of high operating efficiency and the maintenance of the plant in first class condition. The chief engineer is also brought into the higher councils of the organization, is consulted and has a voice in all matters concerned with works policy, plant development and productivity considerations.

The Americans have proved that considerable benefits are derived from the policy of giving the chief engineer executive status and bringing the engineering division into closer alignment with production. This can only be done if properly paid men are available and are employed in all levels from the boiler house operator upwards.

Because of the high standard of competence of engineering personnel, American industry spends money with confidence on equipment, such as automatic boiler controls, boilerhouse instruments and mechanical devices to achieve higher efficiency in its plants, in the knowledge that it will be properly operated and efficiently maintained.

Not only does this provide means of raising the standard of efficiency but it ensures proper measurement of plant performance and permits proper records to be kept, leading to the accurate costing of steam and power. Hence the interest of management in the efficiency of plant operation, an interest much to be desired and conducive to good plant performance.

The most important result is that American industry has taken full advantage of the operator's skill in the sense that expenditure on reserve and stand-by plant has been reduced to a minimum. The team saw ample evidence of this at almost every boiler plant visited.

This complete report, 102 pp, 7 by 10 in. paper bound, is available from: the British Productivity Council, 21 Tothill Street, London SW 1, England for 5 shillings per copy; and from the Office of Technical Services, Department of Commerce, Washington, D. C. for $1.35. The postpaid price of 5 shillings is approximately 70 ct. and can be paid by international money order. The editors DO NOT have copies.

Level Measurement and Control Methods—Take Your Pick From These

For nearly every liquid level to be measured, one particular device will do the job better than any other. In recent years many new methods have been developed; here's a review of the most important in use today

By W. B. JARZEMBSKI *

ALL INDUSTRIES without exception are eventually faced with a problem in which level is concerned.

* Chief Engineer, Instruments, Inc.

In the oil industry, measurement and control of level is a major problem on which millions of dollars have been spent and although many methods have been developed the search for better ones continues.

The aircraft industry has never completely solved the problem of determining the exact level of fuel in the tanks of airliners and the Navy

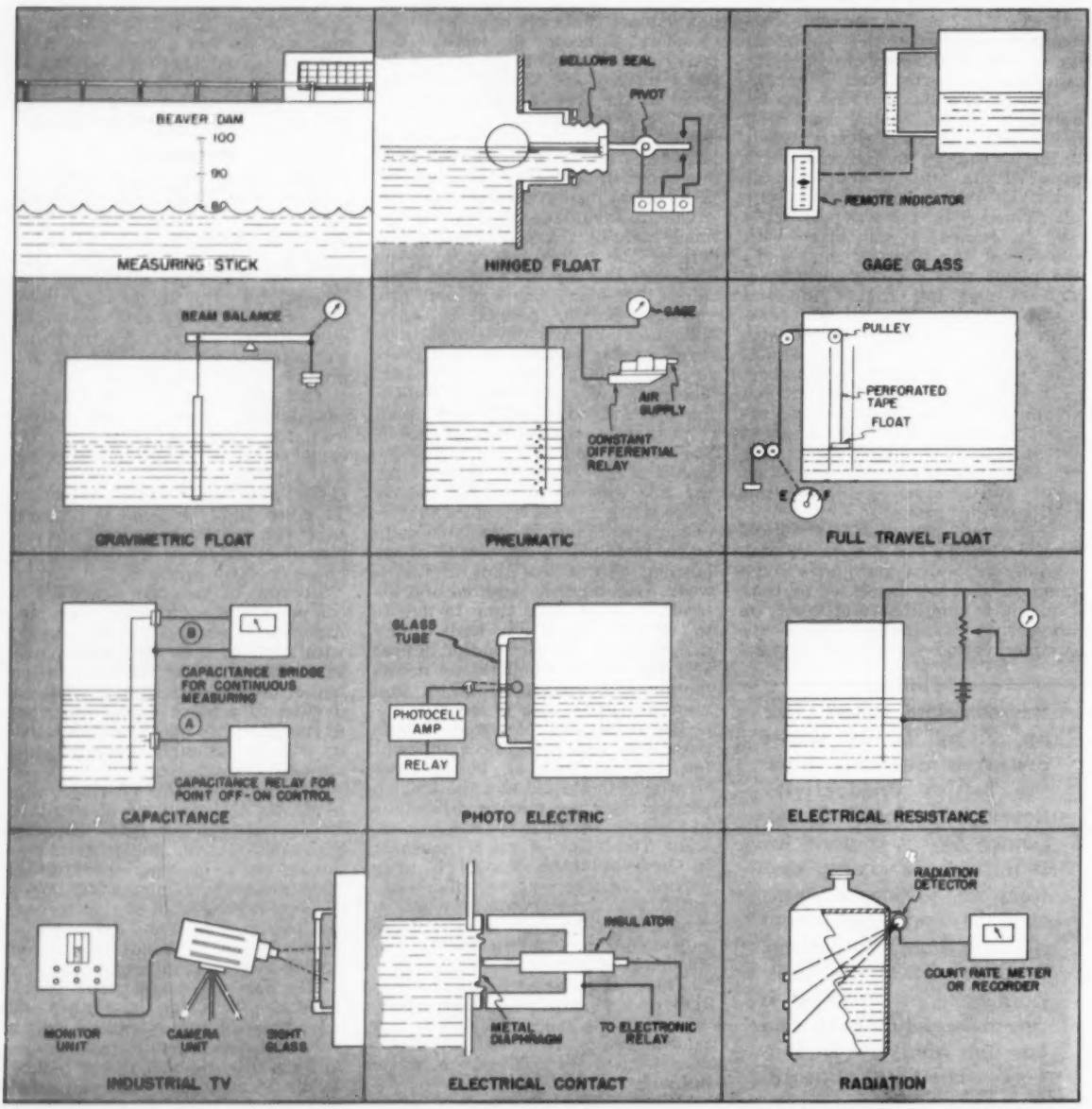


Fig. 1. Diagrams showing the basic principles of some of the most commonly used level measuring devices in modern power plant and industrial practice

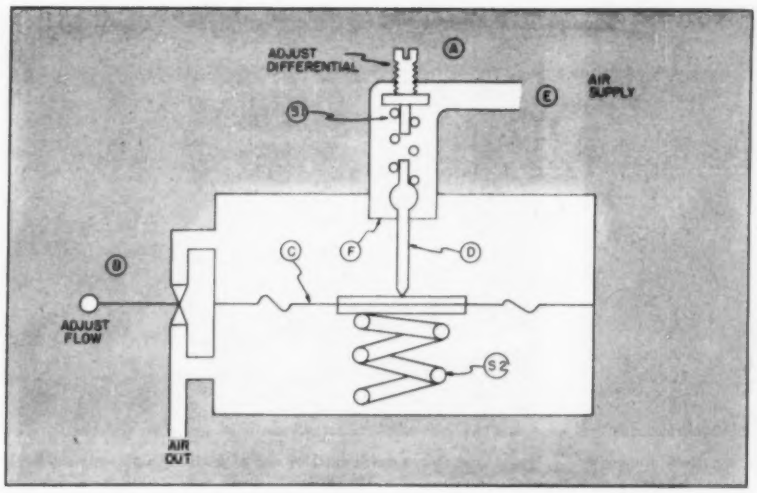


Fig. 2. Constant differential relay used in pneumatic system of level measurement as explained in text

would be very happy to purchase a device for indicating remotely the exact amount of water in the boilers of modern vessels.

There have been many satisfactory means developed for measurement and control of level and this paper will explain in general terms the more important of these methods. The accompanying illustrations have been made to show the basic means of measuring level in each instance.

Manual Methods

Probably the oldest means of measuring level is the use of a graduated stick. This means is still in widespread use where high accuracy and remote reading are not necessary. Good examples of this are the marking on a ship's hull to determine the vessel loading. Swimming pools have the water level marked on the side of the pool and tank cars are often gauged by means of a graduated stick. The usual procedure for refueling airliners is for a man to climb up on the wing and insert a calibrated stick in the gas tank. This method has the advantage of its surety as well as the low costs of equipment. Disadvantages are the inaccuracy, loss of permanent record and possibility of fire when explosive materials are being measured. It is often difficult or impossible to measure granular materials in this manner.

The next step in liquid level measurement was the use of floats. This consists of placing a float in the liquid being measured. There are three general types of floats in use today.

The hinged float is the most popular type of float used for measurement or control of level. Millions of these units are in daily use on hot air furnaces to maintain the proper level in a small tank which supplies water to the automatic humidifier. The hinged float is generally used over short distances and often supplies only off — on operation or control over a very narrow range of levels. Many hinged floats are in use however for indicating the level in fuel oil tanks as well as the amount of gas in the tanks of automobiles.

The moving float is widely used for precision measurements where readings are used for billing purposes. The most common form consists of a large diameter lightweight float, a perforated tape, a series of pulleys and an indicator located outside of the tank. Due to the large diameter of the float and light weight, there is little variation in the liquid line of the float due to changes in specific gravity of the liquid being measured. This system is used for remote indication of level from oil or chemical storage tanks where extreme accuracy is necessary as well as indication of level within elevated water tanks where very inaccurate results are acceptable. In both these applications the results are obtained at a minimum cost.

Float Systems

The gravimetric float makes use of the change in weight of a body as it is surrounded by a liquid. This system consists of a "float" that will not float in the liquid being measured and a method for weighing this float. The principal advantage of this system is the elimination of large travel for any part of the system and the simplicity of installation. This float converts level to a force and as such is particularly adaptable to proportional control by means of standard pneumatic devices. This method, however, is susceptible to changes in density of the material being measured, and for measurements involving a large range the "float" becomes rather cumbersome. It is also difficult to protect the float from effects of fluid currents without introducing undue friction. The chief advantages of the float systems are their relatively low cost and simplicity of operation. They are generally limited to liquids and maintenance can be a major problem. With all float systems, the problem of friction must be reckoned with, particularly when measuring corrosive or highly viscous materials.

The pneumatic system of level measurement and control uses a source of clean dry air, a constant pressure differential relay to assure a uniform flow of air, a pipe extending to the bottom of the tank and a local or remote pressure gauge.

With a flow low enough to make friction negligible, the amount of pressure necessary to force air from the bottom of the dip pipe will be a direct measure of the pressure at this point. This pressure is dependent upon the density of the liquid being measured, the height of the liquid and the pressure on the top of the liquid. This pressure is obtained from a constant differential relay. The constant differential relay is a device for maintaining a constant pressure drop across an orifice, within the relay and thus supplying a small constant flow.

A typical constant differential relay is shown in Fig. 2. The functioning of the relay is as follows: With no air pressure, the valve rod (D) is in a position to open valve (F). When air is supplied at (E) a pressure is created on the upper side of diaphragm (C) which causes this diaphragm to move down closing valve (F) until air passes through valve (B) and into the lower chamber. The diaphragm will reach an equilibrium position to which the following equation applies.

$P_1A + F_{s1} = P_2A + F_{s2}$

P_1 = Pressure on top of diaphragm
P_2 = Pressure on bottom of diaphragm
A = Area of diaphragm
F_{s1} = Force due to spring S_2
F_{s2} = Force due to spring S_1

If the air supply pressure increases and the downstream air pressure does not change, this will cause pressure P_1 to increase upsetting the balance in the above equation and causing the diaphragm to move down. This closes the valve (F) and lowers pressure P_1 until the old pressure is reestablished.

If the air supply pressure does not change but the downstream pressure drops due to a change in level of the liquid measured, the diaphragm will move down closing the valve and lowering pressure P_1 until an equilibrium position is reached.

Thus the pressure P_2 will represent the pressure at the bubbles dip pipe and will be unaffected by changes in supply pressure.

Air Problems

An alternate method is available where a diaphragm and nozzle replace the dip tube at the bottom of the tank. This is useful in processes where it is not desirable to have air bubbling through the liquid being measured.

This system is relatively inexpensive, rather accurate and easily in-

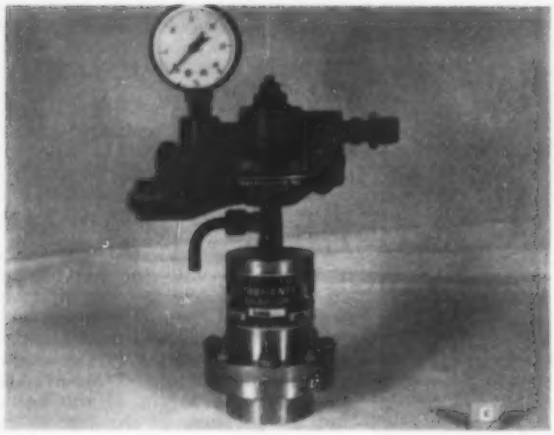


Fig. 3. Example of constant differential relay with pneumatic transmitter

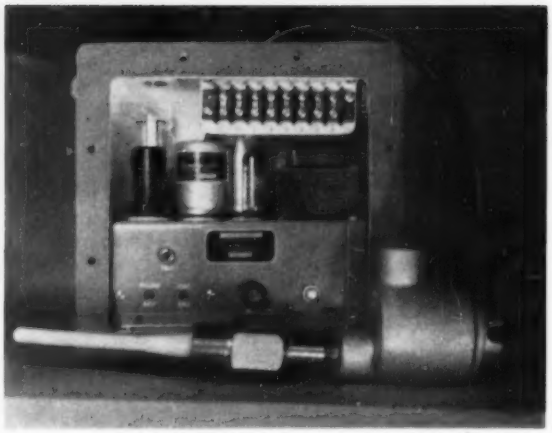


Fig. 4. Capacitance operated relay and probe for liquid level measurement

stalled. It has the advantage of furnishing an output of air pressure which may be worked into most pneumatic control devices. The principal disadvantages are the dependence on density of the liquid being measured and the need for a supply of clean dry air. The latter problem does not apply to most plants as the normal instrument air supply may be used.

Electrical resistance has been used as a means of measuring level but has not been very successful due to the dependence on electrical resistivity of the material being measured and the difficulty of keeping the electrodes clean. The resistivity of distilled water from one boiler may vary by a factor of five in a week's time, without the water being harmful to the boiler.

Electrical Capacitance

The measure of electrical capacitance is being used successfully for measurement of level of liquids, gases and granular materials. There are two general types of instruments in use for this type of measurement. The first uses a small probe to detect changes in capacitance for off — on operation. This instrument uses a radio frequency oscillator which oscillates when the capacitance is low and stops oscillation when the probe is covered and the capacitance is high. Units of this type have been built which will operate when the probe is covered with a single bubble of soapy water. This type of level indicator is used for hazardous locations, high pressure locations, high temperature locations and with liquids which are highly corrosive. This unit is not affected by changes in density or temperature and is affected by changes in dielectric constant only when the interface level between two materials with similar dielectric constants is being detected. A typical instrument of this type is shown in Figure 3. This particular instrument was designed for use in hazardous areas.

The other type of capacitance level measurement uses an insulated probe placed in a vertical position within the vessel. This probe extends the full length of the measured portion of the level and is unlimited in length. This probe will exhibit a certain capacitance to the vessel wall when surrounded by air with a dielectric constant of 1. As water (or any other material) covers the probe, the capacitance between the probe and the vessel increases. This change is measured with a suitable bridge and gives an instantaneous reading of level. This instrument is affected by the dielectric constant and temperature of the material being measured but can be automatically compensated for these effects by means of a small auxiliary probe.

Capacitance probes have not been in use for a long enough period of time to fully evaluate their effectiveness but they have the advantage of having no moving parts; the probes may be constructed of materials with infinite life even under adverse conditions, and maintenance is a relatively easy matter. The principal disadvantage is the use of electronic components, but present day design can produce instruments of extreme reliability and accuracy.

Photo electric cells have been used for detection of level changes by putting a light source on one side of a sight glass and a photo cell on the opposite side. The output from the photo cell is amplified and operates a relay when a certain level has been reached. This type of level detection has never become very popular for it is affected by changes in color of the liquid, aging of the photo cell, aging of the light source and dust on the sight glass or other parts of the system.

Radioactive Indicators

Radioactive-type level indicators are often able to measure levels not measurable by any other means. There are two types, one for off — on or point detection and one for continuous level indication over ranges from 0–6″ to 0–40′.

The off — on type of level controller consists of a source of radiation such as radium or cobalt 60 mounted on one wall of the vessel at the level to be detected. A radiation detector is mounted diametrically opposite this source in the same horizontal plane. With the level above this point most of the radiation is absorbed by the material whose level is being measured. The detector receives very little radiation and a relay is operated. With the level below this point most of the radiation is received by the detector and the relay does not operate.

The continuous level type of instrument uses a radiation detector on one side of the vessel and one or more radiation sources located either in the vessel or diametrically opposite. These radiation sources are located below the radiation detector and as the absorption of radioactivity is dependent on the mass of material between the source and the detector any change in level will cause a change in received radiation.

Corrosive Materials

This instrument finds its principal use in measuring level of extremely corrosive materials, abrasive materials or materials under such pressure that it would be difficult to make a sealed hole through the tank for the use of any other type of instrument. The principal disadvantage of this type of instrument is its relatively high cost. This cost becomes insignificant, however, when a level must be measured and no other instrument will do the job.

A recent means for measuring level for remote transmission is the use of industrial TV equipment. This system uses a camera unit focused on a sight glass or gauge and a receiving unit at the remote location. This unit may not function when trouble occurs but it never gives an inaccurate picture. Main disadvantage is high initial cost of equipment, as well as difficulties encountered in servicing these units with plant personnel who are not familiar with this equipment.

Steam Alone Powers New System Using Unit Heaters

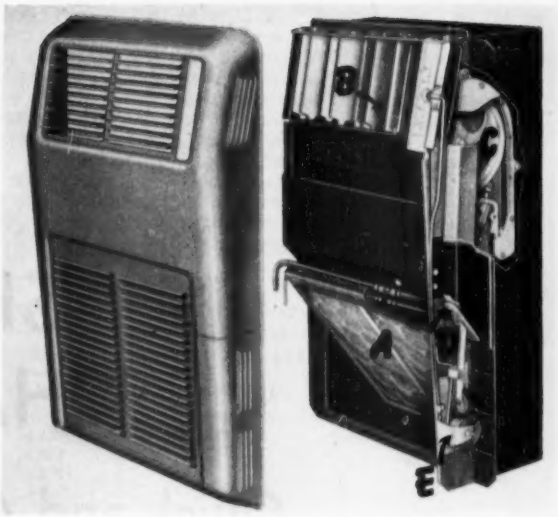


Fig. 1. An individual heater with grille removed, showing: A, air filter; B, circulating fan; C, fan turbine; D, free-floating damper; and E, a bi-metal helix

USING nothing but low-pressure steam to drive the air supply fans and heat the air, with no electric motors wiring nor controls, the modulated zone heating system shown on Fig. 3 has been recently developed. It is designed to supply fully-modulated, zone-controlled, filtered-warm-air comfort heating for office and industrial buildings and homes.

One big advantage claimed for this system, apart from the absence of electric wiring, is thermostatic control for each unit, designed to allow each room in a house or each zone in a factory to be kept at any desired warmth whatever the temperature of the rest of the system.

The system consists of a number of individual heaters, Fig. 1, located as desired in the spaces to be heated and supplied with low-pressure steam from a steam generator unit as shown. The steam drives a small steam turbine in each heater, which in turn drives an air circulating fan in the heater. The exhaust steam from the turbine flows to a copper-core heat exchanger, which heats the air from the fan as it is discharged into the room. Condensate from the exchanger flows through a return line back to a steam-turbine-driven condensate pump, which returns it to the steam generator.

Room air enters the unit through the lower grille, Fig. 1, passes through a spun-glass type air filter, over the heating coil and then to the circulating fan, which discharges it into the room through upper adjustable-vaned openings.

A sensitive, rugged thermostat controls the heat output and the speed of the circulating fan by regulating the supply of turbine steam while a bi-metal helix controls a free-floating damper which adjusts the circulation of room air. No electrical controls are used.

The system is designed to provide individual room air circulation, compensate for external heat, give zoned control, respond quickly and have low initial and operating cost.

For more information about this new heating system, write the Editor, POWER ENGINEERING, or write "zone heating" on one of the postage-free return post cards elsewhere in this issue.

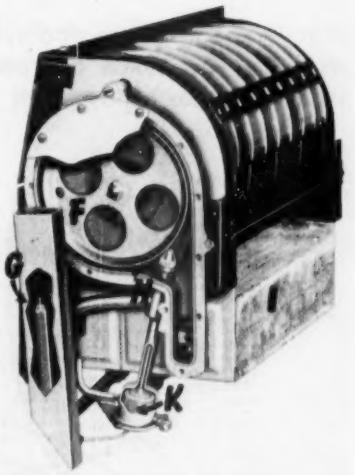


Fig. 2. Internal view of a heater, showing: F, the fan turbine; G, thermal bulb; H, steam throttle valve; I, heat transfer core; K, throttle valve bellows

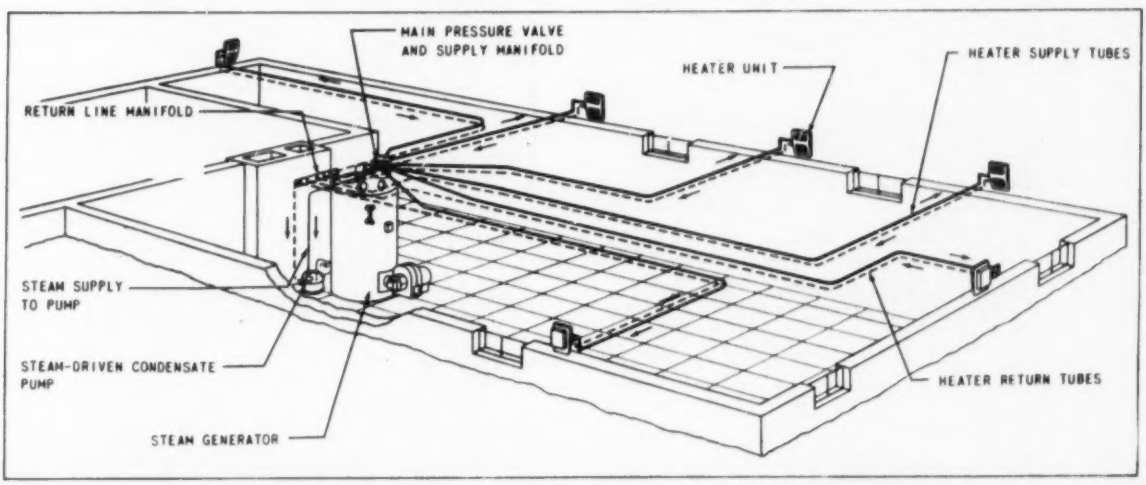


Fig. 3. Diagram of central manifold system of modulated zone heating, in which individual supply tubes connect boiler to each heater and individual tubes return condensate to pump. System can also be 2-pipe, or can be down-feed for slab construction. Each heater unit has independent thermostatic control

PIPE SIZING CHARTS

Quick and Accurate

If you expect your heating system to operate smoothly and economically your steam and condensate piping must be properly sized. Here are handy charts for finding right pipe sizes quickly

By **WILLIAM W. GAYLORD** Consulting Engineer, Torrington, Conn.

THERE ARE MANY data available on the carrying capacities of pipe but most of it is in such form that its use is tedious or, at best, slow. The table of constants for use in the Babcock formula published in the ASH & VE Guide give good results but require the use of four values for each length of pipe sized. There have been several alignment charts published on steam flow in pipes but all these require three or four operations for each length of pipe.

Tables of pipe capacities, in either flow in pounds per hour or number of square feet of radiation supplied, have been published for various initial pressures and a series of pressure drops. To use those tables it is first necessary to choose the table nearest the expected working pressure; second, to choose the pressure drop that can be allowed per 100 ft of pipe; then, from the proper line in the table, select the pipe size required.

Pressure drop that can be allowed per 100 ft of pipe depends on the initial pressure and the length of run from the boiler to the most distant heating unit or radiator. Pressure drop from source — boiler or reducing valve — to the most distant heating unit in a low pressure system

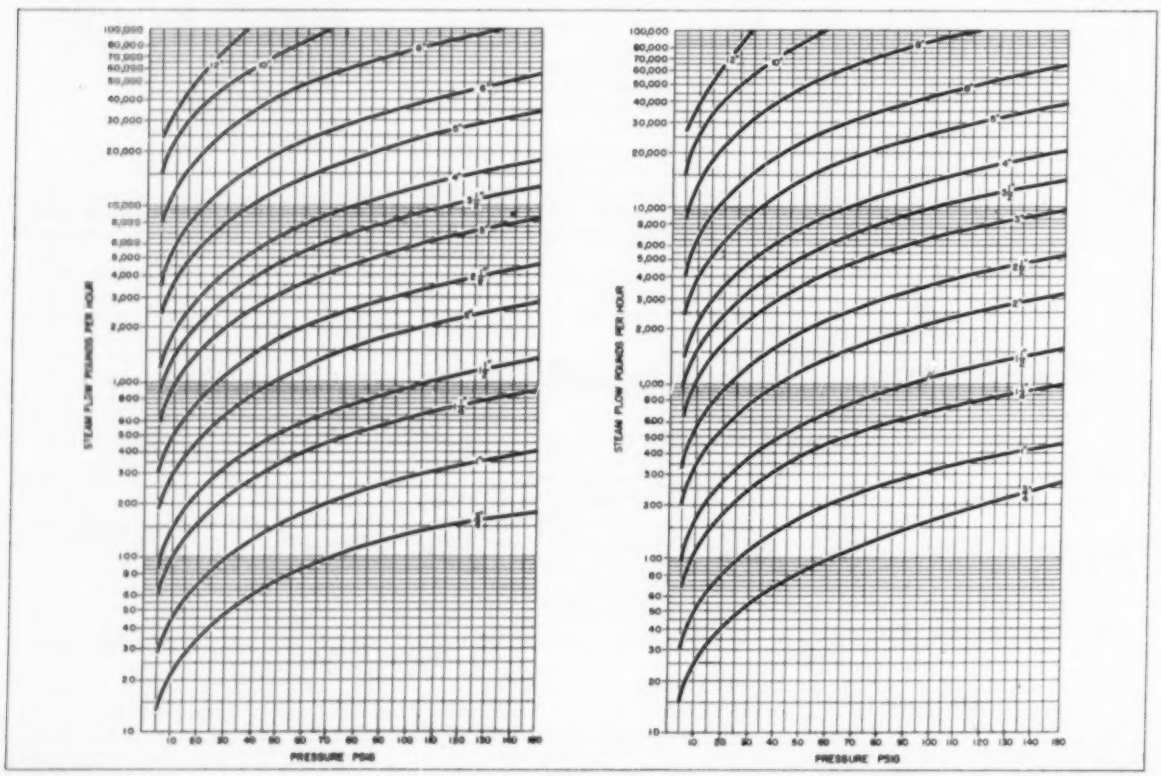


Fig. 1. The left hand chart is for use with a pressure drop of 3.75 per cent per 100 ft. The right hand chart is for a pressure drop of 5.0 per cent per 100 ft.

(under 15 lb) is 15 per cent to 20 per cent. For systems with pressure 25 lb and above it is 25 per cent to 30 per cent. These values have been found practical.

If two or more operating pressures are to be compared in designing a system the use of the tables and charts mentioned above becomes rather tedious. For a quick method of determining the pipe sizes of any system, I have prepared and used charts showing the pounds of steam per hour that various commercial pipe sizes will deliver with pressure drops of 2.5 per cent, 3.75 per cent, and 5.0 per cent per hundred feet of pipe for pressures from 5 lb to 150 lb gage. I have also prepared a chart to show the condensate flow in pounds per hour for the different pipe sizes over the same pressure range.

To illustrate the use of these charts assume a low-pressure steam heating system is to be designed where the distance from the boiler to the most distant unit heater is 600 ft and the maximum flow in the main is 6000 lb per hr. The main will supply three branches, each of which takes 1500 lb per hour; runouts from the main and the branches to unit heaters each take 150 lb of steam per hour.

As the exact layout of piping, fittings, valves, etc., has not been determined, the equivalent length of pipe to the last unit heater will be assumed as 1.25 times the actual length so this system will require the use of the 2.5 per cent pressure drop chart. It is designed to compare pipe sizes, let us say, for both 5 lb and 12.5 lb operating pressures.

As a second comparison let us assume a system at 40 psi operating pressure which will require the use of the 3.75 per cent pressure drop chart. Then, the pipe sizes will be as shown by the table.

It is always desirable to maintain a uniform pressure drop, insofar as possible with commercially available pipe sizes, throughout the length of a system; sizing by the use of these charts makes this much easier. It will usually be found that the total drop from the source to the last heating unit will be somewhat less than the percentage drop of the chart used inasmuch as most of the pipe sizes chosen will not be working at their full capacity.

Table I. Pipe size in inches for assumed heating system used in text to show use of these sizing charts

Section	Steam Flow Lb per Hr	5 Psig		12.5 Psig		40 Psig	
		Supply	Return	Supply	Return	Supply	Return
Main to First Branch	6000	8	4	8	3½	5	2½
First to Second Branch	4500	8	4	6	3	4	2½
Second to Third Branch	3000	6	3½	5	3	3½	2
Third Branch to End	1500	5	2½	4	2	2½	1½
Runouts to Heaters	150	2	1	1½	1	1¼	¾

If you want additional copies of these charts write to the Editor, or use one of the prepaid post cards you will find elsewhere in this issue. Just write PIPE SIZING CHARTS on the card and mail it to us

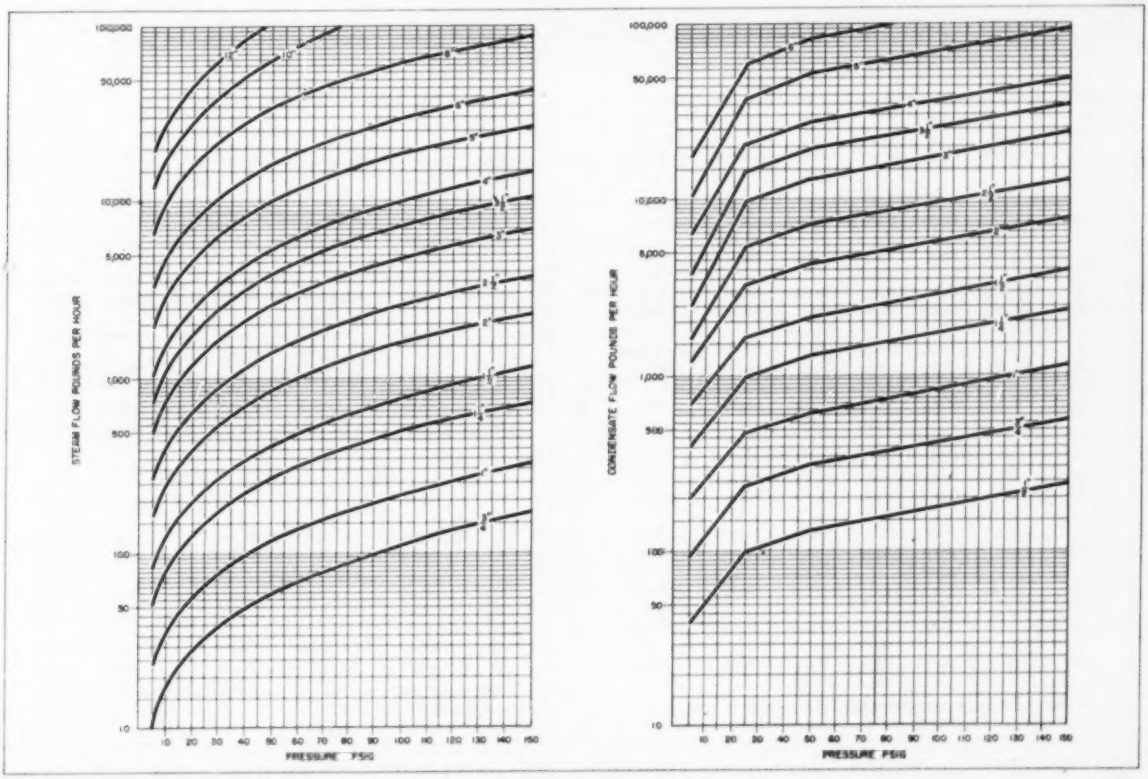


Fig. 2. The left hand chart is for use with a steam supply pressure drop of 2.5 per cent per 100 ft. The right hand chart is for sizing condensate piping

Proper Coatings Just as Important for Fiber Materials as for Metals

Fiber materials such as wood, cotton, rope and paper can deteriorate even more rapidly than metals without good protection. Here are some points to help you select proper paints and varnishes

By L. G. JONES

PAINTING OR COATING fiber materials has become as important in industrial operations as painting metallic surfaces. Coating fiber materials includes penetration of the paint into the body of the material, often to a considerable depth or even to complete saturation. When we stain wood shingles on the roof or sides of a building, the wood absorbs the paint stain like a blotter. Without this penetration the coating would be inadequate.

By fiber materials we mean organic vegetable or animal products composed mainly of cellulose fibers. Examples are wood, cloth, rope, yarns, paper and similar materials.

Many industries spend large sums of money in preserving these materials or reducing replacement costs when they fail. Power, telephone and telegraph industries make every effort to preserve and lengthen the life of their wood poles, crossarms, timbers, rope, and cables. The cost of moving wires and equipment from one pole to another exceeds the mere cost of replacing the pole itself.

Railroads protect their crossties as well as their poles by coating them with protective paints. Shipping companies watch their docks, piles, sails, tarpaulins, rope and other fiber materials. Jungle rot cost our armed forces and our taxpayers a vast fortune in waste of materials until new protective coatings were devised. We all worry about the wood portions of our homes for fear of losses due to decay, termites and other forms of destructive insects and fungi. Farmers now paint their crops, livestock, buildings and soil with insecticidal and fungicidal paints.

Industrial wood products, such as poles, ties, cross-arms, timbers, logs, marine piles, etc., are now production coated by means of pressure dipping in creosote oil or other preservatives. The properly selected trees of southern pine, western red cedar, Douglas fir, Western larch, etc., are cleared of branches, bark, and extraneous material and are brought for conditioning to the pole yard, tie plant, saw mill or other production center or treating plant. Conditioning means removing excess moisture from the wood, reducing it from over 50 per cent to below 25 per cent, depending upon the kind of wood and its ultimate use. Poles, piles and logs can be treated in the green or raw state in the paint or preservative tanks by applying steam pressure at temperatures about 250 F, or by filling the tanks with preservative oil at about 200 F for 4 to 12 hours. A vacuum of about 22 in. Hg is then applied to the tank, the oil and the wood. This reduces the boiling point of the water in the wood to about 150 F and moisture is drawn from the wood so that it literally runs out of the tank as a stream of water. The cells of the wood which have been emptied of their water by the vacuum now become filled with the preservative oil under pressures up to 200 psi. Com-

Sample No.	Weight increase	Finish	Gloss	Color change	Blistering	General appearance
			SUBMERGED PORTION			
A	123.7%	Poor	Poor	Marked	Few small	Bad
B	92.9%	Poor	Very poor	Some	None	Poor
C	116.3%	Poor	Poor	Some	None	Bad
D	84.4%	Good	Poor	No change	None	Fair
E	147.2%	Bad	None	Bad	None	Very bad
F	85.4%	Fair	Very poor	Some	None	Good
G	79.3—	Fair	Very poor	Very slight	None	Fair
			HUMID ATMOSPHERE PORTION			
A	—— *	Poor	Fair	Marked	None	Bad
B	——	Good	Very poor	Some	None	Poor
C	——	Fair	Poor	Some	None	Fair
D	——	Very good	Good	No change	None	Good
E	——	Very poor	None	Marked	None	Poor
F	——	Fair	Very poor	Some	None	Good
G	——	Good	Very poor	Very slight	None	Good

* Humid atmosphere caused practically no gain in weight

Table I. Fungus growth on wood panels coated with various clear varnishes. Effects compared for humid atmosphere and immersion in tap water at 70 F for 40 days. All samples were plastic type except B, which was a spar varnish

Sample No.	Decay or softness	Discoloration	Grain swelling	Slimy surface	Fungus growth Black	Fungus growth Green
		SUBMERGED PORTION				
A	Some	Considerable black	Some	Marked	Some	Some
B	Slight—edges	Some—grey	Slight	Slight	Slight	None
C	Some	Considerable black	Some	Slight	Slight	Slight
D	None	Very slight grey	Very slight	None	None	None
E	Some	Some—grey	Very slight	Slight	None	None
F	None	None	Slight	Slight	None	None
G	None	Very slight	Very slight	Slight	None	None
		HUMID ATMOSPHERE PORTION				
A	Some	Bad black, grey	Some	——	Marked	Some
B	Slight—edges	Some	Slight	——	Some	Some
C	Some	Bad black, yellow	Some	——	Some	Some
D	None	None	None	——	None	None
E	Some	Bad black, grey	Slight	——	Marked	Marked
F	None	None	Slight	——	None	None
G	None	Some brown	Slight	——	None	None

* Since these portions were not submerged under water, slime could not collect.

Table II. More important properties of clear varnishes compared for same wood panel samples listed in Table I, and under same conditions of humidity and immersion in tap water. Final rating was given after 40 days' exposure

pressed air is used in the empty-cell process of treatment to control the quantity of oil retained in the wood. After the oil has been drained from the tank, final steaming may be applied to the wood to remove surplus oil and to keep the wood surfaces clean.

Some treating plants apply the preservative coating to wood products by dipping them into hot and cold preservative baths successively in open tanks. The method of putting the preservative into the surfaces of the wood is often dictated by the species of the wood and its cellular or fiber structure. The American Wood Preservers' Association, through its various technical committees, has set up standard methods for applying these coatings to various wood products with specifications for the different preservative oils, depth of penetration into the wood, quantity of oil to be retained per cubic foot of wood, and so on.

Until recently, wood products, especially large sections, such as logs, poles, piles, crossties, etc., were dried in the air. With this method, the pieces are carefully stacked in alternately crossed piles that are openly spaced to permit maximum circulation of air over the surfaces of all the pieces. These piles of wood, often covering large areas, stand from 30 days to 9 months, gradually losing moisture, and getting their shrinkage and fiber saturation set for further treatment.

Drying in kilns with steam or air heat is the method commonly used for smaller finished lumber. Drying in vapors has been developed for better control of shrinkage in short time drying even for large timbers, logs and poles. Such drying cuts the time from months to hours. Improper processing in this very important drying phase can cause shrinkage cracks, warpage and other faults. Initial steaming or heating to temperatures of 200 F or above serves to sterilize the material.

Many types of preservative coatings are now in use. Creosote oil has been the long accepted standard. New developments, however, have produced pentachlorophenol, copper naphthenate, water soluble salts of many trade names, such as greensalt, Wolman salts, chromated zinc chloride, and so on. The Forest Products Laboratories of the U. S. Department of Agriculture, and the American Wood Preservers' Association have published many technical studies on these preservatives. The American Standards Association and the A.S.T.M. have added their specifications to help engineers and those interested in fiber material preservation.

Consideration should be given to the fungicidal value of any coating used on materials that may be subject to decay. Fungi require moisture. They absorb and retain moisture in the area they occupy and thus spread over larger areas and deeper into the material. Table I shows the effect of various types of clear finishes on wood panels. The lower half of the panels, after coating and drying, were submerged in tap water. The upper half remained in a moisture saturated atmosphere at 70 F. for 40 days. This table shows only a few of the many tests run on various clear varnishes on wood panels.

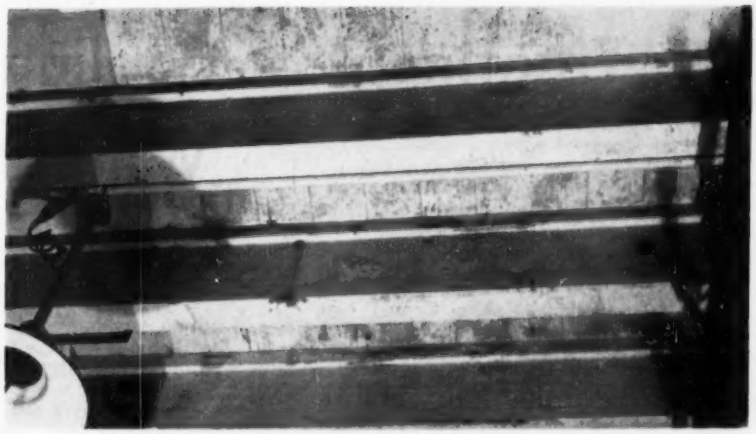


Fig. 1. Frame ceiling of cooler room exposed to molds and decay, painted with a standard packing-house pigment paint containing no fungicides. Completely covered with mold after three months' exposure

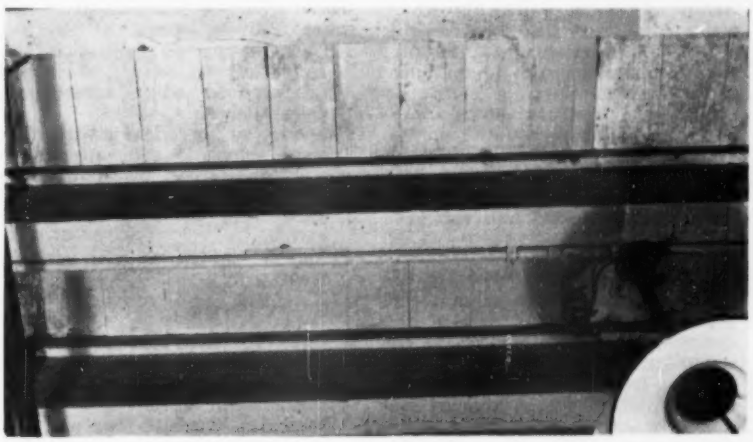


Fig. 2. Same ceiling as shown in Fig. 1, but painted with packing-house paint to which solubilized copper-8-quinolinolate was added. Both illustrations are by courtesy of H. R. Richardson, Armour and Company

Though laboratory results may not be right at all times, they can generally be depended upon to point out defects under accelerated conditions. The tests in Table 1 show in 40 days what will eventually appear on the job in a much longer time. Many people are often skeptical of laboratory results, feeling that the real tests should be applied in the field. This is undoubtedly true, but very expensive and slow where paint testing is concerned. The laboratory can certainly pick out the poorer samples so that maintenance or production departments can do their more elaborate trial work on those products that are shown to be best by laboratory tests.

As a follow-up on these fungus findings, listed in Table I, the other more important properties evaluated in the tests are enumerated in Table II. These properties and the method of test were described in POWER ENGINEERING, Oct. 1950. The same methods will be used in comparing other types and uses of paints in following discussions.

A study of the two tables shows the relationship between the action of fungus on a given paint and its fungus receptivity and other qualities. Paint is often blamed for failure that is really caused by fungus attack and decay of the paint and wood that the paint is supposed to protect. Once the film is punctured, osmosis and penetration of moisture is helped by the spread of fungus.

The inclusion of some fungicide in paints that are to be applied to wood and fiber products that are exposed to wetness, or the treatment of the wood products with fungicide prior to painting, would add much to the life of the wood. This protection becomes increasingly important when the wood is subjected to marine or tropical conditions.

Treatment of Cooling Waters

By L. W. FITZPATRICK *

INDUSTRIAL PLANT systems utilizing continuous aeration to lower water temperatures by evaporation through cooling towers, spray ponds and air washers, constantly introduce quantities of gases, dust and living organisms which increase scale formation and corrosion.

The tendency of natural or "raw" waters to corrode piping and metal plant equipment has long been a problem of water chemists. Initially, an attempt was made to minimize corrosive attack by a controlled alkali feed, which laid down a protective calcium carbonate coating. This proved impractical because of the narrow limits within which such a treatment had to be maintained to avoid both corrosion and extensive scale formation.

Inorganic Corrosion and Deposits

Calcium carbonate precipitation which takes place in recirculating systems is not due mainly to the water temperature rise as it passes through heat exchange equipment, since (in an efficiently-designed system) this is held within 15 F with a maximum circulating water temperature of 120 F. Aeration and evaporation taking place with each cycle through heat exchange cause a continual loss of carbon dioxide from the water, with bicarbonates shifting to carbonates with lower solubility and consequent deposition.

Scale can be minimized by a combination of the following systems now in use. However, each system requires close regulation and control for efficiency and a complete analysis should be made based on plant raw water analysis, equipment required and general over-all plant operation.

1. *Hydrogen acid zeolites* which will not produce sodium bicarbonate or carbonate.
2. *Sodium zeolite softening* with sufficient sulphuric acid after-treatment to convert bicarbonates to sulphates.
3. *Lime soda softening* to remove carbonates.
4. *Soluble phosphates* and blended treatments.
5. *Sulphuric acid* converting carbonates to sulphates.
6. *Chromate* based treatments.
7. *Systematic blowdown* schedule to control dissolved solids in circulating water at all times.

Soluble phosphate control provides a stabilizing effect converting water to a compound that is neither scale depositing nor corrosive over a wide temperature range and plant operating conditions. Polyphosphates and complex organic materials inhibit precipitation growth to prevent sludge and scale deposits in equipment.

Polyphosphates and organic materials are combined because results are superior over single utilization. Over-all treatment cost ranges from 0.1 to 3.0 cents per 1,000 gal make-up water with an over-all dosage of 2 to 5 ppm.

Metallic phosphates, fusion products of sodium phosphate and metallic oxides are often utilized and have the advantage of introducing a metallic ion into solution without adding an undesirable negative ion. Increased solubility, greater stability, controlled toxicity and desirable cathodic and anodic properties, give valuable aid in minimizing scale and corrosion.

Carbonates, when converted by sulphuric acid to su'phates, minimize calcium carbonate oversaturation to provide a higher concentration cycle and reduce blowdown. Reduced chemical requirements and make-up water are the results.

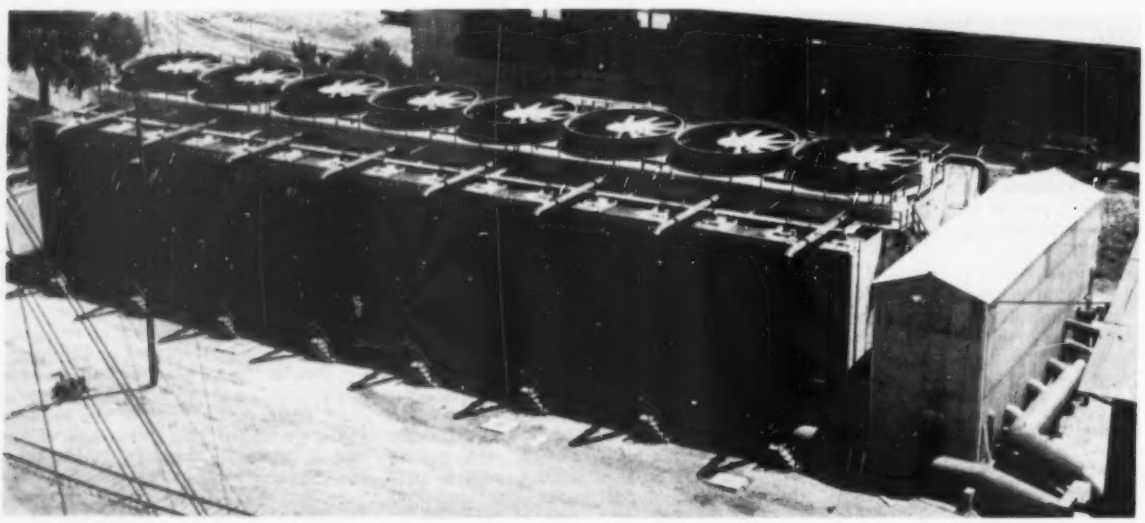
Water treatment companies offer improved blends of chromates, phosphates and inorganic synergists to use with a system range of 6.0 to 6.5 pH. This effectively prevents scale and corrosion under such adverse conditions as: organic, sewage and other water supply contamination; high sulphate and chloride waters; sulphate-reducing bacteria or sulphides in raw supplies; high water temperatures and soft water make-up.

Under this low pH range, calcium as $CaCO_3$ can be carried as high as 1000 ppm without scale formation, and chromate film inhibitors effectively halt corrosion.

Blowdown Necessary

Systematic blowdown is required regardless of the treatment system employed. As evaporation occurs, mineral solids remain in increasing concentrations — exactly as in a steam boiler. Make-up water is easily calculated on the basis of the calcium

* Chief Engineer, Department of Corrections, State of Missouri.



Constructed entirely of California redwood, this huge cooling tower was erected without nails or fasteners of any kind. The tower's maximum capacity is 40,000 gpm, cooling from 95 to 80 F, and measures 193 ft long, 63 ft wide and 40 ft high. Installation is at the Pueblo plant of Colorado Fuel & Iron Co.

carbonate saturation index. This was originally developed in 1936 by Prof. Langelier and various refinements and improvements have been added since that time. This index permits pH value calculation wherein any water is saturated with calcium carbonate at a given temperature. The actual pH value can be determined at which a given calcium content and alkalinity is in equilibrium and balance.

It is not possible to determine how much calcium carbonate can deposit, since soft waters exhibit less ability to resist change by physical or chemical cause than a hard water under the same index.

Proper use of Table IV can, however, give ample warning of scale-forming conditions and suggests means of prevention.

Organic Deposits

Algae (blue-green and green) restrict water and air flow in towers and flourish in portions of the system exposed to light and air. Many species are identified in these classes, but their over-all action and growth are practically identical. Diatoms (unicellular algae) are sometimes confused with mineral deposits because of the silica composition of their shells. Different species of diatoms behave identically in depositing formations in piping and filters.

Bacteria (slime formers, corrosive sulfate reducers, iron depositors, and semi-non-troublesome types) form thick, soft slime. Corrosive sulphate reducers change sulphur compounds to sulfides accelerating corrosion. The iron deposits familiarly known to plant operators are *Crenothrix*, *Callionella* and *Leptothrix*, and stem from well supplies. Oxidization of iron compounds give life energy to

Table II. (Right) Recirculating system water requirements for a 10 F rise

Make-up for Windage and Loss (Per Cent)	Number of Water Concentrations	Make-up, lb water required per each lb steam condensed, or for every 1000 Btu's of heat loading		
		Evaporation	Windage & Waste	Total
10	10.0	1.0	0.11	1.11
20	5.0	1.0	0.25	1.25
30	3.33	1.0	0.43	1.43
40	2.5	1.0	0.67	1.67
50	2.0	1.0	1.0	2.0
60	1.67	1.0	1.5	2.5
70	1.43	1.0	2.33	3.33
80	1.25	1.0	4.0	5.0
90	1.11	1.0	9.0	10.0
100	1.00	0	100.0	100.0

Table I. (Below) Methods and efficiencies for evaporative cooling of water

Type Installation	Per Cent Cooling Efficiency		
	Minimum	Average	Maximum
Spray Ponds	30	40–50	60
Spray Filled Atmospheric Towers	40	45–55	60
Atmospheric Deck Towers	50	50–60	90
Mechanical Draft Towers	50	55–75	93

Table III. (Below) Chemical reactions occurring in raw and treated waters

Typical Water Reactions In Cooling Systems

(1) $Ca(HCO_3)_2$ + ↑ = $CaCO_3$ + CO_2 + H_2O
Calcium Bicarbonate — Heat — Calcium Carbonate — Carbon Dioxide — Water

(2) $2Fe(HCO_3)_2$ + $\frac{1}{2}O_2$ = Fe_2O_3 + $4CO_2$ + $2H_2O$
Ferrous Bicarbonate — Oxygen — Iron Oxide — Carbon Dioxide — Water

(3) $4Fe$ + $3O_2$ = $2Fe_2O_3$
Iron — Oxygen — Iron Oxide

Converting Calcium Bicarbonate By Acid Treatment

(4) $Ca(HCO_3)_2$ + H_2SO_4 = $CaSO_4$ + $2CO_2$ + $2H_2O$
Calcium Bicarbonate — Sulfuric Acid — Calcium Sulfate — Carbon Dioxide — Water

Table IV. (Below) Calculating calcium carbonate saturation and its effects

Total Solids (ppm)	Factor "S"
50–350	0.1
400–1100	0.2

Temperature (F)	Factor "T"
32	2.6
36	2.5
44	2.4
50	2.3
58	2.2
64	2.1
72	2.0
82	1.9
90	1.8
100	1.7
112	1.6
124	1.5
134	1.4
148	1.3
162	1.2
180	1.1

Calcium Hardness (ppm of $CaCO_3$)	Factor "H"
10	0.6
12	0.7
14	0.8
18	0.9
23	1.0
28	1.1
35	1.2
44	1.3
56	1.4
70	1.5
88	1.6
111	1.7
139	1.8
175	1.9
230	2.0
280	2.1
350	2.2
440	2.3
560	2.4
700	2.5
870	2.6
1050	2.7

M. O. Alkalinity (ppm as $CaCO_3$)	Factor "A"
10	1.0
12	1.1
14	1.2
18	1.3
23	1.4
28	1.5
36	1.6
45	1.7
56	1.8
70	1.9
88	2.0
111	2.1
140	2.2
177	2.3
230	2.4
280	2.5
360	2.6
450	2.7
560	2.8
700	2.9
880	3.0

Formulas:

1. Obtain values of factors S, H, T, and A from above tables.
2. $pH_s = (9.3 + S + T) - (H + A)$.
3. Saturation Index is then $pH - pH_s$.
   Index = 0 Water is chemically balanced.
   Index = + Water has scale forming tendencies.
   Index = — Water has corrosive tendencies.

Table V. (Below) Typical analysis of scale removed from a heat exchanger

Physical Appearance: Tan powder, partly magnetic.

Chemical Analysis		Probable Combinations	
Loss at dull red heat	19.6%	Loss on ignition	18.4%
Silica (SiO_2)	3.1%	Silica	3.1%
Phosphorous Pentoxide (P_2O_5)	26.8%	Magnetic Iron Oxide (Fe_3O_4)	0.8%
Ferric Oxide (Fe_2O_3)	15.4%	Basic Calcium Phosphate ($Ca_{10}(PO_4)_6(OH)_2$)	14.7%
Calcium Oxide (CaO)	13.4%	Magnesium Phosphate ($Mg_3(PO_4)_2 \cdot Mg(OH)_2$)	17.3%
Magnesium Oxide (MgO)	8.7%	Calcium Carbonate ($CaCO_3$)	9.3%
Carbon Dioxide (CO_2)	4.1%	Sodium Oxide	0.7%
Sodium Oxide (Na_2O)	0.7%	Iron Phosphate ($CFePO_4$)	27.5%
Copper Oxide (CuO)	7.0%	Copper Oxide (CuO)	7.0%

Analysis: Scale sample shows both scale and corrosion products. Scale components are calcium phosphate, the magnesium phosphate, and calcium carbonate. The corrosion products are iron phosphate and magnetic iron oxide, as well as copper oxide.

Presence of magnesium phosphate indicates that there has been over-treatment at times with the phosphate treatment used. The presence of corrosion products indicates low protective phosphate at times and low pH values at periods.

bacteria which become troublesome in systems because of the slimy iron oxide in piping.

Bacteriologists frequently place undue emphasis on "total bacteria count" in water analysis. The majority of bacteria identified in water samples are not important because they do not clump or cause chemical reactions. Bacterial count should be adjusted by subtracting harmless bacteria from the total count. Presence of large quantitites of any bacteria, however, shows a favorable water environment for all bacteria.

Fungi (molds and yeasts) propagate in equipment where light is excluded. With tough, rubbery surfaces, a mold organism is large compared to a yeast and is difficult to kill chemically, as it continually tangles with other organisms mainly on heat exchange surfaces. Initially, both molds and yeasts enter the system from air-borne contaminants.

Water that contains slime-producing organisms will produce slime only if sufficient food material from normal water and airborne dust combine with favorable temperature conditions. Many natural waters lack food supply and algae requires light to sustain its life.

Control of Organisms

Toxic chemicals control slime-forming organisms, with chlorine being the sole chemical agent that completely destroys slime life. Other toxic agents will poison organisms which can recover when the feed dose is reduced or discontinued. Because of the hazards in handling chlorine gas, many small installations rely on chlorine derivatives.

Neither phenols or copper sulfate will remove slime already present. This requires a complete initial cleaning. Often overlooked is the fact that removal of green algae from cooling towers does not necessarily eliminate other slime formers since they are not usually affected by algae removal treatment.

Inhibit or Destroy?

To determine whether organism growth should be inhibited or destroyed outright, one must know the source and rate of inoculation. The toxic chemical selected should be judged on its effectiveness against all organisms and in addition be capable of efficient penetration and dispersion of slime masses.

Copper sulphate is favorable for simple algae, but is less efficient against green algae. In alkaline water, furthermore, the free hydroxyl ion will precipitate insoluble copper hydroxide which accelerates corrosion. Extremely dilute solutions of copper salts are corrosive to steel and iron.

Maintained chlorine residuals as low as 0.5 ppm effectively kill organisms. Because of its non-selective action in organic content waters and its reaction on dead oxidizable matter, additional chlorine is required to maintain the desired residual. A derivative, "chloramines," has chlorine advantages with the added ability to release chlorine slowly and thus does not react completely with dead oxidizable matter.

Phenols and creosols, toxic to algae and to some slime-forming organisms, are relatively stable in alkaline waters and are non-volatile. Potassium permanganate, sometimes used against algae, has high oxidizing power and is not effective in high organic content waters. Permanganate reduction products, mainly the dioxide precipitates, settle in low system points creating sludge problems.

An algaecide should be used in every water treatment program involving cooling towers and applied before algae is initially encountered. With a large algae growth in a system, considerable dead algae will clog lines as it is carried out.

Easier Tower Maintenance

Delignification, better defined as the chemical deterioration of lumber, is indicated by a soft, stringy and spongy wood structure with a decayed appearance. As tower wood is alternately wet-and-dry, some bicarbonates concentrate and turn to carbonates. This can be prevented by removing all bicarbonates from the system. Many plants report absence of wood attack with circulating waters running less than 8.5 pH.

Cooling tower manufacturers are constantly improving their product by designing for maintenance ease. Mist eliminator slats and supports require the most replacement. Materials other than wood have been used in recent tower installations including transite and masonite wall panels, concrete, and aluminum mist eliminators.

During normal tower operation, the inside structural framework in the lower sections is constantly wet from the falling water while the top is bathed in vapors. Industrial corrosive fumes tend to accelerate corrosion under these conditions, but maintenance expenses can be reduced by the application of coatings with a coal-tar pitch base.

These coatings remain impervious to water in any form and are resistant to most alkaline fumes and vapors. Three coats should be applied, each being five to eight times as thick as conventional paint. The extra thickness is important since this will effectively combat corrosive conditions with a minimum of application expense.

Control methods ultimately selected for corrosion and scaling correction of cooling water problems can contribute much toward higher plant efficiency. Control, adequate treatment, and good operating personnel and supervision will give an efficient water treatment program.

How to Make Flash Steam Calculations

This discussion and handy table showing the percentages flashing makes it easy to figure the amount of flash steam formed and the quantity required for low pressure work. Look for steam in usable quantity in condensate and blowdown

WHEN HOT CONDENSATE and boiler blowdown water under pressure are discharged to a lower pressure, some of the water is flashed into steam. In the case of a continuous blowdown system (where the production of flash steam is continuous) it is often advantageous to use this steam for low pressure work. Resulting economies are obvious, says the *Armstrong Trap Magazine*.

Flash steam table shows the percentage of condensate or blowdown water that will flash into steam. The line "Total Heat in Flash" is the sum of the "Latent Heat" and "Heat of Liquid," which are given in the next two lines. (Latent heat is defined as the number of Btu's given up by one lb of steam when it condenses. Heat of the liquid indicates the number of Btu's required to raise the temperature of one lb of water from 32 F to the boiling point corresponding to its pressure.) The temperature of the water remaining after flashing is given in the line "Temp. of Liquid." The volume per lb of flash steam is given in the last line.

Examples

To understand the use of this table, assume a continuous blowdown system discharging 20,000 lb per hr, at 200 psig and 387 F, to a flash tank at 40 psig. Using the table, answer the following questions:

(1) How much flash steam is produced?

(2) What is its latent heat?

(3) How much of this flash steam is needed to heat 1000 gal of water per hr from 50 F to 180 F?

(4) If the remaining unflashed water is passed through heat exchangers where its temperature is lowered 100 F, how much heat will be extracted (assuming 100 per cent heat transfer efficiency)?

(5) What will be the temperature of the water as it leaves the last heat exchanger?

Answers to these problems are calculated as follows:

(1) Enter the table at 200 psig initial pressure and follow the line across to the 40 psig final pressure column to find 11.5 per cent. *Answer:* 20,000 lb per hr × 0.115 = 2300 lb per hr.

(2) Follow the 40 psig column down to the "Latent Heat" line. *Answer:* 919.5 Btu per lb steam.

(3) The heat required to heat one lb of water from 50 F to 180 F is 130 Btu. There are 8.3 lb per gal of water (approx.). Heat required to heat 1000 gal per hr = 1000 gal per hr × 130 Btu per lb × 8.3 lb per gal = 1,080,000 Btu per hr. The steam required is found by dividing the heat required by the latent heat of the steam. *Answer:* 1,080,000 Btu per hr ÷ 919.5 Btu per lb steam = 1175 lb steam per hr. (This leaves 1125 lb steam per hr available for other low pressure uses.)

(4) There are 20,000 − 2300 = 17,700 lb water per hr left after flashing. Lowering its temperature 100 F releases 100 Btu per lb for work. *Answer:* 17,700 lb per hr × 100 Btu per lb = 1,770,000 Btu per hr.

(5) Follow the "Temp. of Liquid" line across to the "40 psig" column to find the initial temperature of the unflashed water (287 F). Find the final temperature by subtracting 100 F from this figure. *Answer:* 287 F − 100 F = 187 F.

Table showing percentage of water flashing to steam when the pressure on the water at boiling point is dropped, and showing steam and water conditions

INITIAL PRESSURE psig	TEMP. of LIQUID Deg F	PER CENT OF FLASH STEAM AT FINAL PRESSURE								
		Atmos.	5 psig	10 psig	15 psig	20 psig	25 psig	30 psig	35 psig	40 psig
100	338	13.2	11.8	10.6	9.6	8.7	7.8	7.1	6.4	5.7
125	353	14.8	13.4	12.2	11.2	10.3	9.5	8.8	8.1	7.4
150	366	16.3	14.8	13.7	12.7	11.8	11.0	10.3	9.6	8.9
175	377	17.5	16.2	15.0	14.0	13.1	12.2	11.6	10.9	10.2
200	387	18.7	17.2	16.1	15.1	14.3	13.5	12.8	12.1	11.5
225	397	19.7	18.3	17.2	16.2	15.4	14.6	13.9	13.2	12.6
250	406	20.7	19.3	18.2	17.2	16.4	15.6	14.9	14.3	13.6
300	421	22.4	21.1	20.0	19.0	18.2	17.4	16.8	16.1	15.5
350	436	24.0	22.7	21.6	20.7	19.9	19.1	18.4	17.8	17.1
400	448	25.5	24.1	23.1	22.2	21.5	20.6	19.9	19.3	18.7
450	459	26.8	25.5	24.4	23.5	22.7	22.0	21.3	20.6	20.1
500	470	28.0	26.8	25.7	24.8	24.0	23.2	22.6	22.0	21.4
550	480	29.2	27.9	26.8	26.0	25.2	24.4	23.8	23.2	22.6
600	488	30.3	29.0	28.0	27.0	26.3	25.6	24.9	24.4	23.8
Total Heat in Flash (Btu per lb)		1150	1156	1160	1164	1167	1169	1172	1174	1175
Latent Heat (Btu per lb steam)		970.3	960.0	952.0	945.2	939.1	933.6	928.5	923.9	919.5
Heat of Liquid (Btu per lb)		180.0	196.1	208.3	218.7	227.8	235.9	243.2	250.0	255.9
Temp. of Liquid (Deg F)		212	228	240	250	259	267	274	281	287
Steam Vol. (Cu ft per lb)		26.8	20.0	16.3	13.7	11.8	10.4	9.4	8.5	7.7

Normally, a state-owned power plant serving state institutions leaves its financial well-being in the hands of bookkeeping departments at the state capital. This plant is unusual in that it operates on a revolving fund replenished only by what it receives by selling its services to its exclusive clientele —Wisconsin State Prison and the Central State Hospital. They are billed on the first of the month and promptly pay by check. Wisconsin's businesslike approach pays dividends in economy and reliability of services

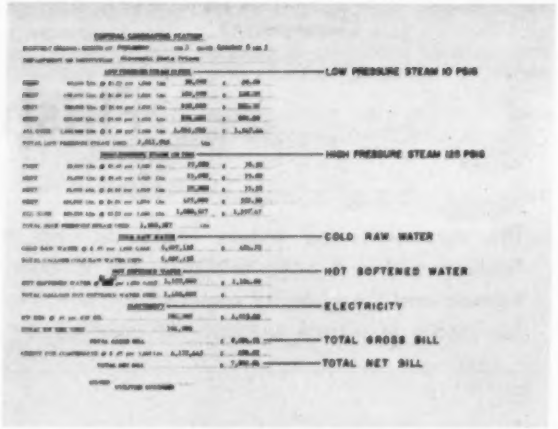


Fig. 1. Typical statement such as is issued each month to each customer. Rates shown in table are set up experimentally by the state and may be changed

Metering and Cost Control Keep State Power Plant on Cash Basis

WARDEN JOHN C. BURKE was appointed head of Wisconsin State Prison in 1938 and was promptly visited by Chief Engineer A. H. Gesell. After painting a cost-reliability-adequacy picture of prison utilities for the new warden, Gesell had acquired another valuable ally in his fight for a new central generating plant to replace the two existing plants.

As it worked out, Burke and Gesell did not convince enough other people fast enough before Pearl Harbor came. Then hope for a new plant dimmed but was not extinguished. Shortly after the war, Wisconsin acted. A new central generating station was built and was operating by 1951 to supply electric power, high pressure and low pressure steam, cold raw water, and hot soft water to a total of 10 customers.

Two institutions are served by the new plant, the Wisconsin State Prison and the Central State Hospital — but within the prison are eight industrial users, all of which use all five services of the Central Generating Station. The industries are: (1) cannery, which operates from May 15 to December 15; (2) paint manufacturing plant; (3) shoe manufacturing plant; (4) laundry for institutions; (5) tailoring industry; (6) printing shop; (7) metal shop, including machine shop, metal furniture shop, and another shop for manufacturing license plates and wood-and metal-furniture; and (8) twine manufacturing plant.

Fig. 2. Utilities Engineer A. H. Gesell operates the new Central Generating Station for Wisconsin

Services Metered

Meters at the power plant measure services to the prison and hospital. Within the prison there are separate meters for each of the industrial users. The industrial loads are summed up and subtracted from the total prison load to give the total for which the prison alone is responsible. Condensate return is checked closely to determine hardness. If it is maintained at zero hardness, it is credited to the user at $.07 per 1000 lb.

Revolving Fund

At this point, accounting procedures become somewhat unorthodox, at least unorthodox compared to other state-owned plants serving institutions. Meter readings are recorded on a statement, Fig. 1, which is sent to the customer with a bill for the service. Payment is not on paper (merely juggling the books until someone at the capital is satisfied); the customer must send in his check promptly or get his water (etc.) cut off.

On July 1, 1953, the State of Wisconsin deposited $25,000 to the account of the Central Generating Station as a basis for its revolving fund and will add a final $25,000 on July 1, 1954. All shakedown expenses, wages, salaries, fuel bills, in short, *all* expenses for the plant, have to be met from this fund. All receipts for services supplied the 10 customers go into the revolving fund. Rates for those services, as shown by the table are set up by the state.

In setting rates, the State based their calculations on an efficiently run plant, operating at no profit, but still able to keep its operating capital in healthy condition from regular receipts. Waste of funds or inefficient operation of the plant would be reflected immediately by dangerous depletion of the revolving fund. Such prompt revelation of undesirable practices encourages operation char-

Table of experimental rates for utilities supplied Wisconsin State Prison and Central State Hospital by the Central Generating Station at Waupun

LOW PRESSURE STEAM (10 PSIG)		PER 1000 LB
FIRST	50,000 lb	$1.12
Next	100,000 lb	1.08
Next	250,000 lb	1.04
Next	600,000 lb	1.00
All Over	1,000,000 lb	.96
HIGH PRESSURE STEAM (125 PSIG)		**PER 1000 LB**
First	25,000 lb	$1.46
Next	25,000 lb	1.40
Next	25,000 lb	1.34
Next	425,000 lb	1.30
All Over	500,000 lb	1.28
COLD RAW WATER		$ .07 per 1000 gal
HOT SOFTENED WATER		$1.40 per 1000 gal
ELECTRICITY		$ .01 per kwhr
CREDIT FOR ZERO-HARDNESS CONDENSATE		$ .07 per 1000 lb

acteristic of private industry, especially so since no additional funds are forthcoming to "tide the plant over" tough times. Mr. Gesell has operated the plant soundly for the last three years.

Any operation calculated for long-term economy must practice preventive maintenance, especially if it is an operation in which continuity of service is as important as it is to the prison and hospital. As an aid to training and maintenance activities, the utilities engineer has prepared an extremely complete handbook on the operation and maintenance of each equipment item in the plant. This handbook deals not only with equipment, but with the duties of each employee as well. Each man coming to work at the plant is issued a handbook for his personal use.

Plant Improvements

Just as it is difficult to sell the State on a rate increase, it is extremely difficult to sell the utilities engineer on plant improvements which do not contribute to more economical operation. Improvements which result only in theoretical savings serve only to deplete the revolving fund, hence each is weighed carefully before it is approved. Improvements affecting reliability are not ignored, however, as attested by the new 100,000-gal, 130-160-ft water tower just completed and the purchase of a standby diesel-powered 8-in. water pump financed mostly from their post-war building fund. The standby pump was obtained from war surplus stock. Projected for the near future, new fans to increase the overfire air flow are expected to improve efficiency more than enough to cover their cost.

Another step in the direction of greater economy was their recent switch from a low-grade strip mined coal to a premium coal with low sulphur and low ash content. Among the principal reasons for this change were fire prevention and decreased maintenance, both attributed to lower sulphur content. Available figures also show a decrease in coal consumption while load on the plant increased.

The Plant

Water for the plant comes from a deep well on the property and is pumped into storage by a 600-gpm deep well pump. An underground storage reservoir holding 500,000 gal is supplemented by the new 100,000-gal water tower. Manual level controls are used in the tower tank, and these (plus the 5-ft diameter standpipe) tend to minimize ice jams in the tank outlet. Two 700-gpm motor-driven pumps boost raw water into the tower at 160-ft head. These pumps are to be increased to 800 gpm.

Coal comes into the plant by rail and is dumped into a track hopper. A steel belt conveyor moves the coal into a pivoted-bucket conveyor which runs in a continuous loop over and under four indoor storage bunkers, one of which is for a future boiler. Coal on the live storage shelves flows by gravity onto automatic scales, which discharge into spreader stokers. Coal in dead storage can be discharged into the pivot-bucket conveyor for elevation to live storage or for recirculation to other bunkers in the event of fire.

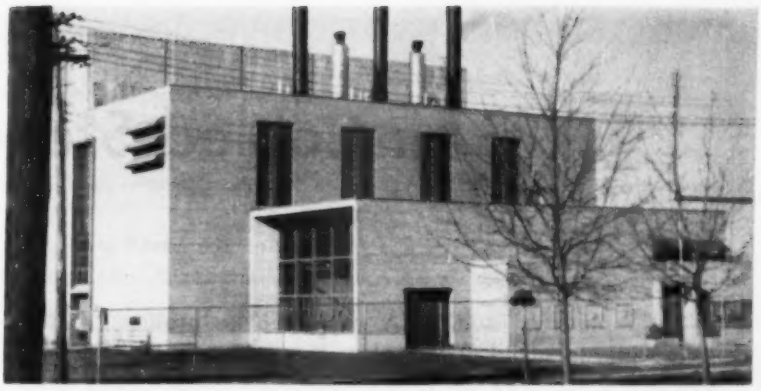


Fig. 3. Pleasing appearance and clean operation of the plant were important because of residential area location. Success of the engineers-architects Battey & Childs is self-evident in this recent photograph

Spreader stokers fire three 30,000-lb-per-hr, 4-drum, Stirling-type boilers, which operate at 430 psia (max 475 psia) and 640 F. A high percentage of the coal is burned in suspension, and fly ash is re-injected and burned. Forward-moving traveling grates dump ash into hoppers, where it is picked up by a pneumatic ash-handling system. This system, operated by a condensing eductor, stores ash in a bunker for periodic unloading by a dustless unloading system. Effluent from the last stage is discharged to the sewer.

Automatic boiler controls regulate draft and coal feed. Both forced and induced draft are employed, and overfire air (to be increased) is injected through nozzles.

Principal treatment of boiler water is accomplished in a hot process (lime-soda ash) softener, and phosphate and sulfite are added. "Hot soft water" supplied the institutions is treated in a zeolite softener with manual backwash controls.

Two three-stage 1000-kw turbines drive 1250-kva generators to supply electrical power for the institutions. One turbine is an automatic extraction unit extracting at 125 psig and exhausting at 10 psig. The second turbine exhausts at 10 psig without extraction. Both units operate at 7988 rpm with gear reduction to 1200 rpm. Power is generated at 4160 volts and is reduced near load centers to 440 volts for power and 120 volts for lighting. Eight vault-type substations at the prison and one at the hospital, each contain two banks of step-down transformers.

Extraction steam (125 psig) supplies the high pressure steam system for the various customers and a pressure reducing and desuperheater station supplements or provides an alternate source from the 425 psia system. Exhaust steam (10 psig) supplies the low pressure steam required by the customers. Another reducing station takes 125-psig steam from the high pressure system and steps it down to supplement the turbine exhaust or replace it when the turbines are shut down.

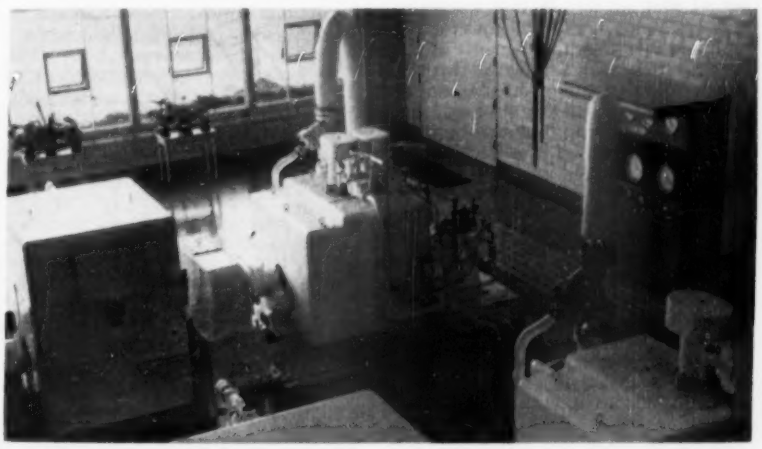


Fig. 4. Turbine room as seen from first mezzanine reveals that the good looks of the exterior were effectively brought indoors. One of the 1000-kw units is automatic-extracting, both non-condensing

How to Figure Air-Cooled Steam Condenser

By H. B. WAYNE

In the September issue, A.L.A. presented his problem: Available water is limited as well as badly contaminated. He wants to install a 1000-kw extraction condensing steam turbine generator. (Question No. 513): Can he use an air-cooled steam condenser and how would he figure it? Here is Wayne's reply

AS MENTIONED in the "Editor's Note," the information submitted by A.L.A. is not sufficient to permit an accurate study of Question No. 513. Many assumptions must be made, therefore, to present a solution which can guide A.L.A. to a reasonable answer.

It was stated that the turbine desired is rated at 1000 kw and extracts process steam at 10–15 psig. It was also stated that the boilers are designed for 450 psig, but have been operating at 175 psig. "Turbine Performance Data" in Table I gives the thermodynamic properties of the steam as it passes through the turbine and is based on the assumed data indicated in this tabulation.

A heat balance diagram (Fig. 1) shows in elementary fashion the paths of the throttle steam, extraction steam and condensate with their assumed thermal data. One possible arrangement of the air-cooled condensers is shown in Fig. 1.

Condition lines (Fig. 2) were taken from a Mollier diagram using the assumed thermal data. This illustration is distorted to show the enthalpy drops better than can be seen on the actual plot of the Mollier diagram. Fig. 3 is a plot of Willans lines for the high and low pressure elements of the turbine. These lines show the throttle steam quantity and exhaust steam at various loads, including no-load.

Maximum steam flow through the low-pressure end of the turbine for which the nozzles are designed is 15,675 lb per hr when generating 1000 kw at 3 in. Hg back pressure, with the low end inlet pressure at 30 psia. Extraction steam quantity is 20,000 lb per hr. At these conditions, the condenser heat duty = 15,675 (965 – 82.98) = 138,000,000 Btu per hr. This is the maximum heat duty for the condenser, based on the assumptions given in Table I. Flow through the low-pressure end at reduced or throttled extraction pressure varies directly as the ratio of the reduced pressure to the maximum extraction pressure (30 psia). By assuming various inlet pressures to the low-pressure end, the expected heat drop and steam flow to the condenser may be calculated for different kw outputs.

"Air-Cooled Steam Condenser Performance Data" (Table I) lists the thermal and physical requirements for the condensers. Based on the assumed thermal data, the estimated required surface is 86,250 sq ft. For an air-cooled exchanger having an extended surface (fins), the surfaces are expressed as external and internal; external being the sum of the fin and tube area, internal being the tube surface only. The number, diameter and length of tubes determine the number of banks and sections required. Fan data including required draft, efficiency and horsepower can be determined after the condenser design is selected. These and other data may be obtained from the exchanger manufacturer.

As stated above, the lack of required information necessitates assumed data which may be greatly different from that which actually exists. A few suggestions for the guidance of A.L.A. are as follows:

1. By substituting the actual data in the formulae given in the attached tabulations and charts, an accurate study may be obtained.

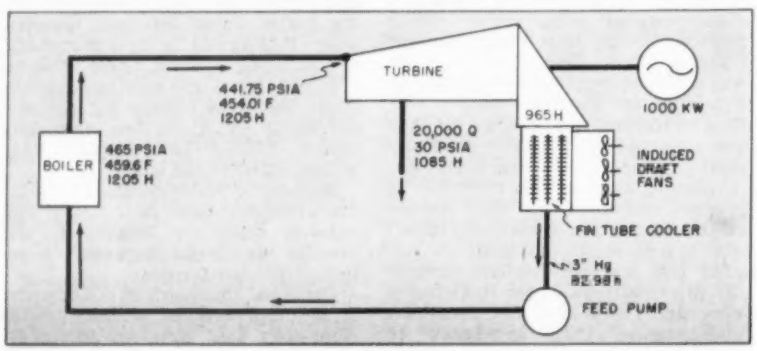


Fig. 1. Heat balance diagram showing paths of the throttle steam, extraction steam and the condensate

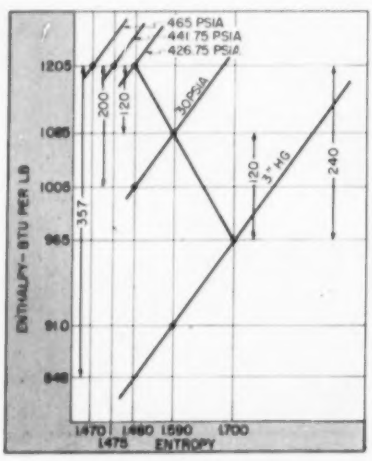


Fig. 2. Condition lines based on the assumed data

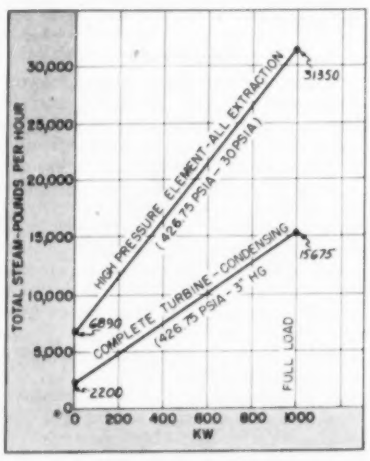


Fig. 3. Willans lines showing steam flow vs. kw

2. If there is a possibility that low turbine loads exist, make sure that provision is made to permit cutting out some of the condenser banks or else extremely low vacuum may result which can lead to mechanical problems for which the turbine and the condenser are not designed.

3. A study of this type warrants considering engaging the services of a consulting engineer who has experience in designing this type of plant and specifying the proper type of equipment. The cost of this service will be more than compensated for by the correct engineering design and economical operation the service will yield.

Table I. Turbine performance data and air-cooled steam condenser performance data for A.L.A.'s proposed 1000-kw steam turbine generator installation

Turbine Performance Data

1. Boiler outlet pressure = 465 psia (saturated), temp = 459.6 F, enthalpy = 1205 Btu per lb.
2. Steam pressure drop from boiler outlet to turbine throttle = 5 per cent of boiler outlet pressure = 465 × 0.05 = 23.25 psi.
3. Steam pressure at turbine throttle = 465 − 23.25 = 441.75 psia, 454.01 F.
4. Pressure drop across main throttle valves = 15 psi.
5. Steam inlet pressure to first stage = 441.75 − 15.00 = 426.75 psia, entropy = 1.48 Btu per deg F per lb.
6. Condenser pressure = 3 in. Hg, abs, 115 F.
7. Heat available with isentropic expansion (constant entropy) between turbine first stage inlet pressure (426.75 psia) and extraction pressure (30 psia) = 1205 − 1005 = 200 Btu per lb*.
8. Internal efficiency of high-pressure end of turbine when developing full load = 60 per cent.
9. Heat utilized by turbine high-pressure end = 200 × 0.60 = 120 Btu per lb.
10. Turbine mechanical efficiency = 95 per cent. Generator efficiency = 96 per cent.
11. Maximum steam flow through high-pressure end when extracting = $\frac{3413 \times 1000}{120 \times 0.95 \times 0.96}$ = 31,350 lb per hr.
12. Available heat with isentropic expansion between initial pressure and condenser pressure = 1205 − 848 = 357 Btu per lb*.
13. Brake potential efficiency for complete turbine, without extraction = 64 per cent.
14. Internal efficiency for complete turbine, without extraction = $\frac{0.64 \times 100}{0.95}$ = 67 per cent.
15. Heat utilized by complete turbine without extraction = 357 × 0.67 = 240 Btu per lb.
16. Maximum steam flow through low-pressure end, without extraction = $\frac{3413 \times 1000}{240 \times 0.95 \times 0.96}$ = 15,675 lb per hr.
17. No-load steam quantity for turbine high-pressure end = 22 per cent of maximum steam flow = 31,350 × 0.22 = 6890 lb per hr.
18. No-load steam quantity for complete turbine = 14 per cent of maximum flow through low-pressure end = 15,675 × 0.14 = 2200 lb per hr.
19. Isentropic heat drop for the low-pressure end = 1085 − 910 = 175 Btu per lb*.
20. Heat utilized by turbine low-pressure end = 1985 − 965 = 120 Btu per lb*.
21. Internal efficiency of turbine low-pressure end = $\frac{120 \times 100}{175}$ = 68.5 per cent.

* Data taken from condition lines, Fig. 2.

Air-Cooled Steam Condenser Performance Data

1. Steam quantity (lb per hr).	15,675	12. Required air quantity (lb per hr).	$\frac{13{,}800{,}000}{0.2375\ (105 - 95)}$ = 5,810,000
2. Steam pressure (in. Hg, abs).	3.0		
3. Steam quality (per cent).	87.0		
4. Steam enthalpy (Btu per lb).	965.0		
5. Condensate enthalpy (Btu per lb).	82.98	13. Air density (lb per cu ft).	0.07
6. Heat transferred (Btu per lb).	15,675 (965 − 82.98) = 13,800,000	14. Air delivery (cfm).	$\frac{5{,}810{,}000}{0.07 \times 60}$ = 1,390,000
7. Air temperature in (deg F).	95		
8. Air temperature out (deg F).	105	15. Overall heat transfer coefficient (Btu per hr per sq ft per deg F).	16
9. Specific heat of air (Btu per deg F per lb).	0.2375		
10. Elevation above sea level (ft).	450	16. Total condenser surface (sq ft).	$\frac{13{,}800{,}000}{16\ (105 - 95)}$ = 86,250
11. Air pressure.	14.5 psia, 29.5 in. Hg, abs		

Cases in Smoke Abatement

Observation Ports Are a "Must"

By C. W. GRUBER *

WHEN A 46,000 lb per hr water tube boiler was installed in a packing plant to meet the growing steam load, an addition to the existing boiler plant had to be built. Because of limited property available, boiler room conditions were very crowded. In fact, the right-hand wall of the boiler was placed against the building wall. The boiler was equipped with a multiple-retort underfeed stoker, complete with automatic combustion controls. The boiler was equipped with an induced draft fan and a new stack for its exclusive use.

Not long after the unit was placed on the line, smoke trouble developed. On the first inspection, it was impossible to determine what was going on inside the boiler because adequate observation doors were not placed in the boiler setting. No overfire air system for smoke control was originally installed. However, steam air jets were added at a later date.

After a number of minor skirmishes between the Smoke Bureau and this plant, a full scale battle developed and the plant is now in the process of determining how the boilers can be fitted with the proper observation doors so that the operators can properly adjust the firing equipment to meet changing load and fuel conditions.

The lesson to be learned in this case is that instruments cannot substitute for observation of the fire itself. The condition of the fire is the key to good operation, and facilities must be provided to observe the fire, to obtain the best combustion.

"He's given up trying to solve his smoke problem. Now he's trying to make it look on purpose"

* Chief Smoke Inspector, City of Cincinnati.

What the Power Engineer Needs to Know About . . .

Centrifugal Boiler Feed Pump Bearing Maintenance

By IGOR J. KARASSIK *

Boiler feed pumps can be effectively sabotaged by a moment's carelessness during assembly of bearings or during the routine maintenance procedure. Installation damage, contaminants in the lubricant, under-lubrication, over-lubrication, and incorrect cooling are discussed in this sixth article of a series

WITH THE exception of packings and sleeves, there is hardly another part of the centrifugal boiler feed pump which requires as much attention as its bearings. All efforts to reduce bearing trouble by overdesign of this component can be nullified by a momentary lack of lubricant between adjacent parts with a high relative velocity. Accidental inclusion of foreign matter in the lubricant has the same effect on these parts.

It is necessary, therefore, to be prepared for bearing trouble and to be able to recognize it promptly. It is also necessary to be able to diagnose the cause of bearing trouble to prevent a repetition after effecting repairs of the bearings themselves. Some companies have called in representatives of bearing manufacturers to instruct their maintenance crews on this subject. This helps to limit the troubles caused by poor technique in mounting bearings on or removing them from the shaft, by using the wrong amount and type of lubricant, and by submitting the bearings to the wrong amount of cooling during operation.

Such difficulties are not necessarily limited to a particular type of bearing, since both sleeve and ball type bearings function well when all design and operating limitations have been properly considered.

Lubrication

Lubrication checks of grease lubricated ball bearings once every three months are often enough. Under reasonably favorable operating conditions, a check each six months is adequate.

Ball bearing housings should not be more than one-third filled with grease normally. This permits fulfillment of the lubrication and corrosion-preventive requirements, and increasing the grease charge will lead to churning and heat generation within the housing.

Before adding grease to a ball bearing, remove all of the old grease. If there is a drain on the housing, remove the plug and inject new grease with the pump running. Stop injecting grease when the new grease shows up in the drain hole. Allow the pump to run ten or fifteen minutes with the drain hole open to drain the excess grease. By this time, the grease will have reached normal operating temperature, the excess will have stopped flowing, and the housing will be about one-third full of lubricant.

When it is desired to clean ball bearings without removing them from the pump, the following procedure is recommended:

1. Wipe the bearing housing thoroughly and remove the grease fitting and the drain plug.
2. Free the openings of any hardened grease with a screw driver or similar tool.
3. Inject some solvent, such as carbon tetrachloride, into the bearing housing while the pump is running. The grease will thin and run from the drain. Continue adding solvent until it runs clear.
4. Flush the solvent thoroughly with a light oil.
5. Add new grease. Replace plug and grease fitting.

When ball bearings are oil lubricated, the bearing housing is provided with an oil level gauge. The level of oil in the housing should be kept as close as practicable to the high mark on the gauge and under no circumstances should be permitted to fall below the low mark. In general, oil levels are maintained so that they are about even with the centerline of the lowest ball in the bearing. Excess of oil has the same effect of churning and overheating as with grease lubrication.

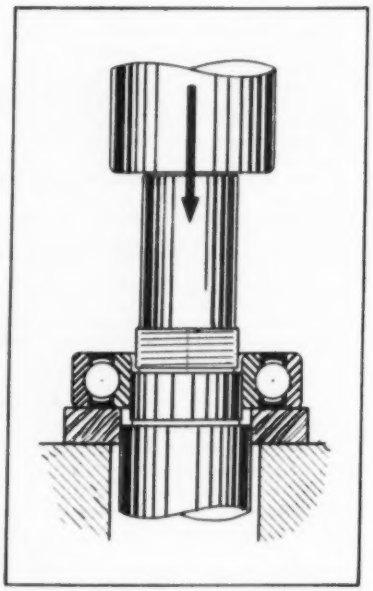


Fig. 1. When removing ball bearing from shaft, use arbor press and support bearing inner race

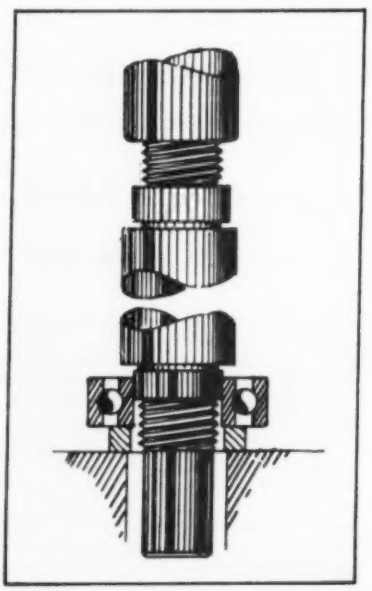


Fig. 2. Arbor press is best also for mounting ball bearings on shaft. Prevent shaft from cocking

* Manager of Multistage Pump Section, Centrifugal Pump Division, Worthington Corporation.

It is advisable to drain oil lubricated bearings periodically, as the lubricant may have deteriorated or be contaminated in some manner. Bearings should then be flushed with very thin oil and then refilled with the standard lubricant.

Bearing Cooling

A very large number of serious ball bearing failures are due to improper cooling. When bearings are provided with water jackets it is frequently assumed that the more cooling is made available, the better will be the bearing operation. Nothing could be farther from the truth. The amount of heat to be removed from a ball bearing — even a thrust bearing — is not very great, if the operation of the pump is normal and if no excess loading on the bearings develops from abnormal causes. As a result, the amount of cooling water required to remove this heat should also be very small.

An overabundant amount of cooling water (and this cooling water is frequently at a very low temperature) results in nothing more than overcooling the outer race and the inner walls of the bearing housing. Because the atmosphere in a power plant is generally quite humid, this tends to condense out appreciable quantities of moisture on the housing walls and moisture quickly finds its way into the supply of lubricant. Such water contamination leads to rusting of the balls and premature failure of the bearings.

It is recommended, therefore, that the water supply to the cooling jackets be sufficiently throttled so that an appreciable temperature rise is permitted between inlet and outlet. An outlet temperature of 100 to 110 F is definitely not excessive.

Removing Ball Bearings

Generally, bearings are mounted on a shaft with either a shrink fit or with a very snug press fit. If possible, a pulling device should be used to remove the bearings from the shaft. The pulling jaws or fingers should be located behind the shoulder of the *inner* race or of its adjacent sleeve. Under no circumstances should pressure be applied to the outer race to force a bearing from a shaft or to the inner race to remove it from a tight fitting bearing housing.

When other parts on the shaft do not interfere, the bearing may be supported by a solid or split ring and the shaft pressed out with an arbor press as in Fig. 1. In many cases, the operation will be facilitated by warming the inner race slightly and thus loosening the initial fit.

To an experienced maintenance man, the appearance of a bearing removed after a failure will frequently suggest the cause of the failure. This diagnosis will frequently help avert a repetition of the trouble. Means to diagnose failures from bearing inspection are generally provided in instruction manuals available from most ball bearing manufacturers and it is a good practice to study this subject thoroughly. It may be even better to arrange for a representative of a bearing manufacturer to provide personal instruction to the maintenance personnel.

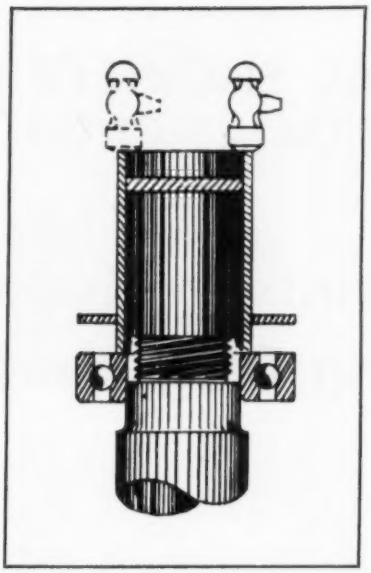


Fig. 3. Tube and hammer provide alternate to arbor press. Hammer tube alternately on opposite sides

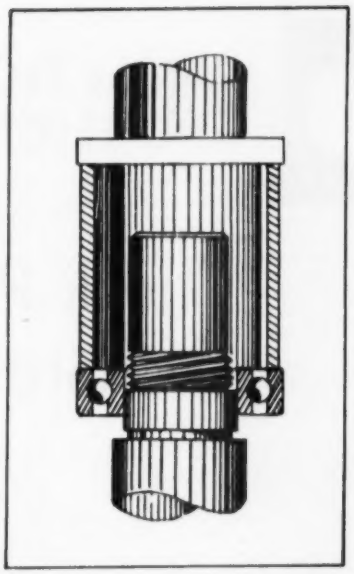


Fig. 4. Never apply force to the outer race when mounting a bearing on a shaft. Bearing will fail

Inspection

A few indications of a general character can be given in an article of this nature, however. For instance, when fine dirt of an abrasive character has entered a bearing housing, it will act somewhat as a lapping compound and both the balls and the races will be highly polished. If the foreign matter is made up of large particles, the races may be gouged instead of polished and dents or scratches may appear both on the races and on the balls.

Corrosion will be distinguished by a dark brown coating of the bearing and by a pronounced pitting of races and balls. Lack of lubricant will give an indication by a high pitch noise when running, a rapid rise in temperature and discoloration of the bearing surfaces through overheating, with a definite bluish tinge which is a sign that the temper of the steel has been lost. Of course a rise in temperature may also indicate overlubrication, but it will seldom be accompanied by the same extent of discoloration.

If the bearings are improperly mounted or misaligned, balls will develop flat spots. If the thrust is excessive or applied in the wrong direction (although most boiler feed pump thrust bearings are arranged to take thrust in either direction), the balls will be forced up to ride on the edge of the race grooves and break up the race surface. The balls themselves may in such cases be sufficiently overloaded so that they actually split.

When remounting ball bearings, it is necessary to remember that the satisfactory operation of any antifriction bearing requires that the inner race be firmly held on the shaft so that no relative motion between the two will occur. On the other hand, the diameter of the shaft must not be oversize so the inner race is distorted. Likewise, the fit of the outer race must prevent its rotation in the bearing housing. As a result, the shaft diameter at the bearing mounting must be checked with a micrometer to insure that it is within the limits, both maximum and minimum, set by the manufacturer, for the size of bearing in question. If necessary to build up the shaft by spraying and grinding, this procedure has to be carried out with great care. The practice of prick-punching the shaft or knurling it to raise metal and make up for a proper fit is definitely *not recommended* and is very dangerous.

Two Methods of Mounting

There are two methods used for mounting a bearing on a pump shaft:

1) Heating the bearing so as to expand the inner race and shrinking it on the shaft.

2) Forcing the bearing onto the shaft.

The first method is by far the safer of the two. The bearing should be heated in an oil bath or in an electric oven to a uniform temperature of 200 to 250 F and then quickly mounted on the shaft, tapping the inner race lightly with a pipe if necessary.

If the second method is used, the force is best applied by means of an arbor press. A ring, solid or split (Fig. 2) is used under the inner race, so that the force is applied to the inner race only. If an arbor press is not

continued on page 111

PRACTICAL ENGINEER AND ELECTRICIAN SECTION

CONTENTS

Repairing Battery Charging Plugs..... 92
Ball-Type Oilers Serviced With Oil Can 93
Self-Closing Gate..... 93
Checking Water Well Levels..... 94
QUESTIONS AND ANSWERS..... 95
What Is Wrong With This Engine? How To Avoid Undue Noise In Air Ducts? How Prevent or Correct Softening of Welded Aluminum Pipe? How Cut FW Heater Losses? How Patch Oil Storage Tank?

Check Points In Repairing Battery Charging Plugs and Receptacles

EVERY INDUSTRIAL battery is equipped with a device for connecting it to the machine it drives and to the charging equipment. Known as charging plugs and receptacles, these devices are made in several sizes in five or more types and are designed to be disconnected easily and quickly. Although these devices are locked together as a unit in use or on charge, they consist of two separate parts: the plug (male half) and the receptacle (female half). One half is shipped with the battery and the other is shipped with the machine such as a fork-lift truck. The battery charging equipment also has leads furnished with either a receptacle or a plug. Obviously, the purchaser of battery-powered equipment must make certain that the same type and size of charging plugs and receptacles are supplied with the truck, battery and charger. He should also be specific as to what units the plugs and receptacles should be attached. Usually, the receptacle is attached to the battery unit and the plugs are assembled to the truck and the charger.

Although plugs and receptacles are of rugged design, they are not indestructible and can be damaged by misuse. Foreign material such as water, grease, oil, dirt, etc., in the receptacle will make it useless unless it is repaired. It may also be necessary to change the size or type of plug.

In repairing a damaged or dirty plug or receptacle connected to a battery, the user must not forget that the leads which terminate in the receptacle are live or "hot" with the total voltage of the battery existing across the terminals. In other words, one lead is secured to the positive post on the battery and the other to the negative. When the terminal lugs are enclosed in the receptacle, they are held apart with little danger of short-circuiting. Before removing the terminal lugs from the receptacle, the battery circuit must be opened or broken. If this is not done and the terminal lugs are accidentally touched together, a short circuit and arcing will occur which can injure personnel and equipment. The strength of the arc will depend on the size of the battery. The amperage carried may reach 10,000 amperes and may exceed the current carrying capacity of the leads. The short-circuit rate will equal three times the one-minute discharge rate of the battery.

To open the circuit, either disconnect one lead from the battery post or sever one of the cell connectors.

The terminal lugs are held in the plug or receptacle by a bolt or screw, which, when loosened, will permit the lugs to be withdrawn for cleaning or for replacement.

After the broken or damaged terminal lug is severed from the cable, the proper length of wire to fit the terminal must be bared, cleaned and tinned. Some terminal lugs have short or shallow recesses into which the wire must be soldered and it is doubly important to clean and tin the wire to obtain a secure bond.

In reassembling the terminal lugs back into the receptacle or plug, make sure that the negative wire is placed in the negative side and that the terminal on the positive lead is secured on the positive side. If the leads are reversed in reassembling, the battery will be placed on charge in reverse and will be badly damaged as a result.

Obviously, when changing or repairing plugs or receptacles connected to the charging equipment, the power should be shut off so that there is no voltage across the terminal lugs and no chance of a short circuit.

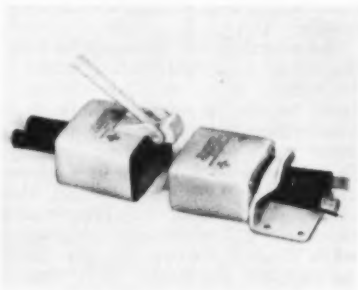


Fig. 1. "Standard" terminal connector showing the locking half at left. Polarity is marked on case

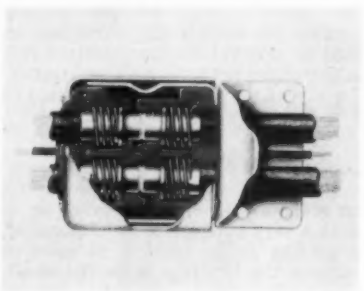


Fig. 2. Internal arrangement of "Standard" terminal connector with its two halves locked together

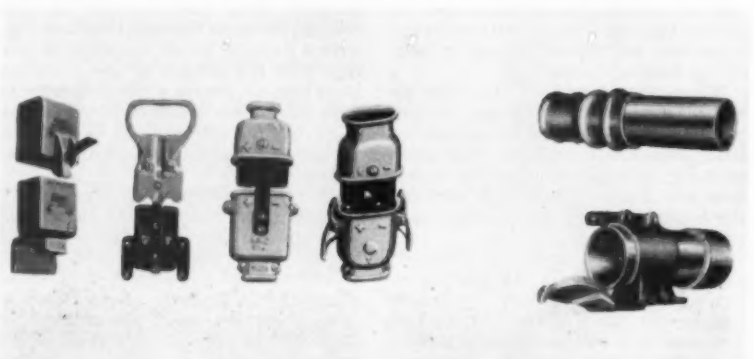


Fig. 3. Left to right, these five types of terminal connectors are: "Standard," "Yale & Towne," "Russell & Stoll," "Elwell-Parker," and "Anderson." The plug half (locking half on the "Standard" unit) is at top

Ball-Type Oilers Serviced With Oil Can

By F. E. RILEY

About the author . . .

Mr. Riley belongs to a breed of cats that is somewhat rare in the United States. In his native England, however, he informs us that many are practicing his chosen profession of free-lance designing. This is a rather specialized branch of consulting engineering which gets most of its business from England's many small manufacturing plants which boast no engineering staff. He contends that the consultant's broad contacts with many employers tend to make him more creative and more valuable to all who buy his services. Jig and tool design and consultation on manufacturing problems have claimed much of his time, but he has managed to develop industrial photography and free-lance writing into a valuable second profession. Many of his articles have appeared in the pages of POWER ENGINEERING during the past few years.

Close-up of adapter for oiling ball-type oilers with an oil can. File handle holds notched tube against ball while oil spout fills through hole

OILING POINTS which have a spring-loaded ball to prevent entrance of dirt normally require servicing by an oil gun which first depresses the ball and then injects oil. If ball-type oilers could be serviced with an ordinary squirt-can, however, they would stand a better chance of receiving proper periodical lubrication.

A simple device which allows the substitution of an oil can for the oil gun can be made as follows:

Cut off a short section of metal tube and insert one end in a file handle. Notch the other end with a file (see illustration) and drill a small hole in the side of the tube above the notch.

Lubricators with very small balls can be entered by pressing down the oil can spout alone, but a notch should be filed across the end of the spout to permit flow. The tube, however, is necessary with large balls since the tip of the spout would slip off their surface and probably buckle before compressing the stiff spring under the ball.

In use, the tube end is pressed down on the ball to unseat it, then the oil can spout is inserted into the hole in the tube wall and oil is injected. Oil runs through the tube, out through the notch on top of the ball, and into the area to be lubricated beneath the ball.

Use of this device ensures that the required amount of oil actually enters the oiling point since it can be seen leaving the notch and flowing over the ball. This is not possible with an oil gun.

Self-Closing Gate

By JAKE ABIG

IN OUR PLANT we have the typical man-lift with the entrance and exit on each floor fenced off with a pipe-rail fence and self-closing gates. These gates are extremely simple to fabricate and would be of considerable interest to anyone wanting a non-clanging, self-closing pipe framed gate to form a good safety barrier.

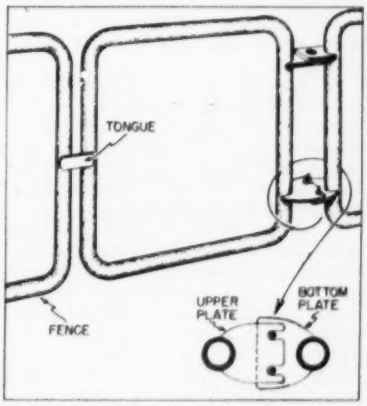
"Don't look on it as a salary cut, Jackson; I'm just saving you from a strong capitalistic tendency."

Hinges to this gate (see illustration) are fabricated from $\frac{1}{4}$-in. boiler plate. The top hinge consists of two plates about 3 in. long and no wider than the outside diameter of the pipe and are welded to the gate and fence as shown. The two hinge plates are pinned together with a $\frac{5}{8}$-in. bolt, drilled for a cotter pin at the lower end, but fitting loosely so that the top hinge plate and bolt can rise freely when the gate is opened.

The bottom hinge consists of two hinge plates and two $\frac{5}{8}$-in. pins. The upper plate is cut out as shown so that the $\frac{5}{8}$-in. pins can fit freely into the notches. Weld the bottom plate to the fence pipe at an angle of about 10 deg to the horizontal with the high side toward the direction in which the gate opens. Weld the $\frac{5}{8}$-in. pin in position on the high side. Support the gate in position and locate the upper plate to set at the same angle to the horizontal and against the lower plate and weld this in place. Open the gate slightly (so that the tongue clears the fence by about $\frac{1}{2}$ in.) and locate the remaining $\frac{5}{8}$-in. pin on the bottom hinge plate. Weld this in place and the self-closing gate is complete.

When the gate is opened, the upper plate of the lower hinge will ride up the slope of the bottom plate while bearing against the pin on the high side. The gate is supported laterally at the top by the top hinge. When the gate is released, it will ride back down the slope of the bottom plate of the lower hinge until the pin on the low side of this hinge engages its notch and slows the swing of the gate to reduce the "clang" of the closing gate.

An occasional drop of oil on both the upper and lower hinges will keep the gate swinging smoothly.



Self-closing gate is fabricated of 1¼-in. black pipe and welded elbows. Hinges are made of ¼-in. boiler plate, a ⅝-in. bolt and two ⅝-in. pins

Electrical Probe for Checking Water Well Levels

By ROY V. GALLOWAY

One power engineer tired of the haphazard but time-honored way he had been checking water well level and draw-down. Result: He did away with the old air tube and vacuum gage and worked out an electrical tattler which tells levels within six inches

Fig. 1. Well probe, reel and megger comprise simple, inexpensive unit replacing static head gage

WITH DEMAND for water at an all-time (and increasing) high throughout the country and water shortages cropping up here and there, power engineers have a not-new but newly intensified problem on their hands. Many of us who considered ourselves blessed with an ample supply of well water have had to curtail pumping to maintain the water table at a safe height. Now we must know much more accurately than ever before how high our water stands, but in many cases it is difficult or nearly impossible to tell.

General practice is to install an air tube along with the deep well pump and attach the tube to an accurate pressure gage. With this gage, it is possible to measure the static head of the water column and thereby obtain the depth. Draw-down, unless over 10 ft, could not be determined accurately, however. Pulling the pump generally results in a damaged (jammed, kinked or cracked) tube despite all reasonable precautions. Replacing the tube each time takes a lot of time and tube.

Our plant has several wells and their levels have varied from 150 to 400 ft. When the table receded and we started to measure level and draw-down, we found that all our air tubes were out of order. Since it was impractical to pull the pumps just to install tubes, we considered other methods of determining these measurements.

It seemed that a device which, when submerged, would use the conductivity of water to indicate its submersion on a megger on the surface would be the simplest and most trouble-free. The first results, however, were not encouraging.

A weight with two insulated contacts (one contact was tried but performed poorly), an electric cord connected to the contacts and used to lower the weight, and a megger on the surface to indicate loss of infinite resistance comprised the first unit. We found that we had shaped the weight incorrectly and that it would catch on obstructions when it was lowered. When the weight had been lowered more than 50 ft before hanging up, those on the surface paying out the cord could not tell that it had caught and continued feeding cord until that, too, was thoroughly entangled. Moreover, the weight would ground out during assembly, water would cling to the weight after submergence and continue to indicate after it was withdrawn, and dripping water from the casing or rocks would cause readings without submergence.

A final model was devised which overcame these shortcomings of the prototype and has been in use now for three years. It will shed water, is unaffected by bouncing off obstructions, and will give readings accurate to within plus or minus six inches. Water level and draw-down can be determined in a few minutes. Fig. 1 shows the device assembled, including the essential wire (or cord) reel.

Assembling Instructions

Machining instructions and parts required are given in Fig. 2. The method of assembling is obvious from the sketch, but some specific instructions might be helpful.

After slipping the marine fitting and the cap over the cord, remove about eight in. of the outside insulation. Be careful not to injure the insulation of the individual wires. Feed these individual wires into the chamber and feed one wire through each of the two holes at the bottom of the chamber. Put some hard-setting electrical compound into the chamber and pull the cord in until it can go no farther. This will force the compound around the wire and a small amount out of each of the small holes.

At this point, ring out for grounds. If no grounds are detected, slide the cap down the cord, apply a sealing compound to the joint, and make up the joint while holding the cord to prevent turning. Repeat this with the marine fitting, tightening the packing nut as much as possible.

The two projecting wires should be cut back so that they project no more than $\frac{1}{16}$-in. from the *bottom* of the depression. Cut back the insulation only $\frac{1}{32}$ in. from the end of the wire, then add a small ball of solder to each tip. The tip, including the solder, must be well inside the depression.

Center each tipped wire and smooth off the compound, leaving a little around each wire just behind the tip. If the circuit checks out without grounds, allow the compound several days to set before using.

On the other end of the cord, allow enough extra length to extend the cord through the side of the reel for connection to the megger. Any system of marking can be used to show the operator how much cord has been reeled out.

Before using the rig in a well, ring it out in a bucket of water for a check.

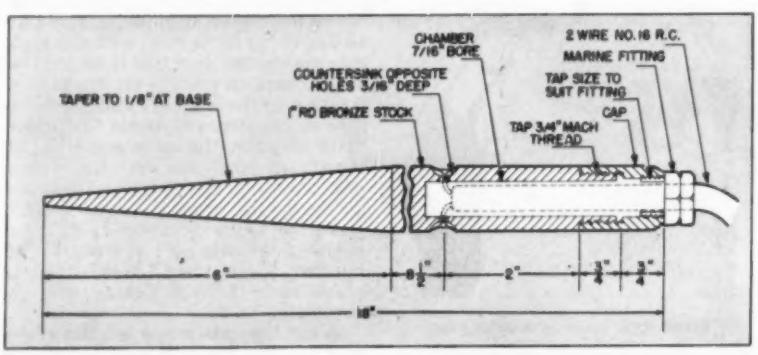


Fig. 2. Machining, assembly and electrical connection details of the bronze probe for well sounding

QUESTIONS AND ANSWERS

Solution of No. 510

What Is Wrong With This Engine?

O. H. D. Reports: Mission Accomplished

I WISH TO THANK POWER ENGINEERING and all those who sent in their opinions and advice on Question No. 510 (August, 1953, issue, page 94). We adjusted this engine as follows:

(1) Substituted 40- for 80-lb spring in indicator.

(2) Adjusted steam rods to admit steam earlier.

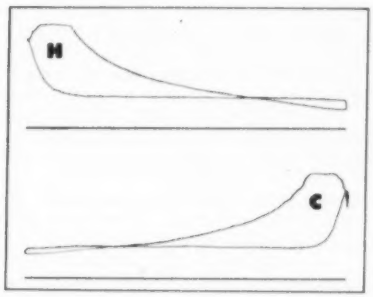
(3) Reduced compression on head end by resetting exhaust valve.

(4) Equalized cut-off on admission valves.

Although these changes did not result in a perfect card, there is considerable improvement. The loop on the exhaust line is probably caused by light load and high back pressure. High back pressure cannot be eliminated since all engines and turbines exhaust into one main exhaust line at 33 psig.

This engine was installed in 1914 and, at that time, was overloaded. Modern machinery and the increased use of electric motors have lightened the load on this engine.

Monroe, Mich. O. H. D.



O. H. D.'s diagram before "the treatment"

Question No. 520

How To Avoid Undue Noise in Air Ducts?

WE HAVE BEEN having difficulty with undue noise in some of our air ducts and would like to know how to avoid this in a new installation we are now considering. What are some of the design characteristics for a noiseless system of air ducts?

J. O.

Answer to No. 515

How Cut FW Heater Losses?

Locate Perforated Pipe Above Water, Baffle Steam Exhaust—Wayne

O. E. STATES that heater uses live steam and he wishes to keep the temperature at 212 F, with 406 psig pressure in the heater. The problem given by O. E. is that approximately 15 per cent of the steam is used for feedwater heating and the large loss of steam is through the exhaust head. O. E. questions if a perforated pipe blowing steam into the water or locating the pipe under the water is feasible.

The following is offered for the guidance of O. E.:

The purpose of a deaerating heater is to remove the non-condensible gases (O_2, CO_2 etc.) from the water. To perform this job it is necessary to elevate the water temperature to bring the gases out of solution. Also required is turbulence to help bring about this separation. O. E. mentions there are trays inside the heater which are used for this purpose at present.

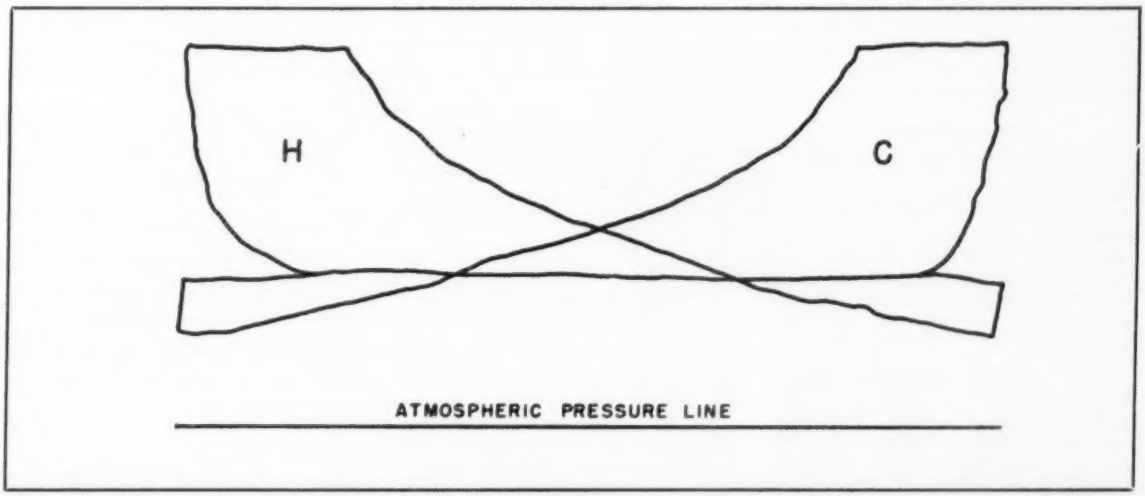
If a perforated pipe is used it should be so located that the fluid leaving the pipe is free to cascade down the trays, permitting separating the gases from the water. Locating the pipe under the water surface will not permit this separation.

With regard to steam loss through the exhaust head, I suggest O. E. review the drawings showing details of the internal design with the idea of installing baffles to eliminate the high steam loss.

The lack of detailed information describing the internal design of the heater does not permit a more sound engineering approach to the problem but the preceding is generally true.

It would be well for O. E. to have the heater manufacturer review the problem and make the necessary corrections as required. The heater manufacturer is far better qualified to undertake a job of this type because of his experience in design and servicing heaters, especially those of their own manufacture. They will give him fullest co-operation.

Brooklyn, New York H. B. WAYNE



Remember O. H. D.'s erratic steam engine (Question No. 510, August, 1953)? This is how his diagram looks after trying some Q & A reader's suggestions. Loops on exhaust ends are due to extremely low load on engine and high back pressure, neither of which can be avoided. Diagram was made with 40-lb spring

Answer to No. 516

How Prevent or Correct Softening of Welded Aluminum Pipe?

Control Cooling Rate Says Barrios

HAVING WELDED and heat treated aluminum and its alloys, I may be able to help with your problem.

Since aluminum and its alloys are hardened by working or heating at certain temperatures for definite periods of time, and softened or annealed by quenching, I would suggest that you lengthen the cooling-off (or air quenching) time of these welds. Cover the tube for a considerable length on each side of the weld with ashes (as in annealing tool steels) to prevent too rapid escape of heat.

It may take several experiments to attain proper hardness. For example, try to hold 500 F to 700 F for about 25 minutes, then air cool or quench. You may have to plug the ends of the tubing to prevent cooling from the inside.

Another suggestion would be to try some of the low-temperature aluminum brazing alloy rods, referred to as 10 per cent silicon rods. All-State Metals Co. and Eutectic Rods are two commercial brands.

Enterprise, Fla. A. L. BARRIOS

Answer to No. 517

How Patch Underground Oil Storage Tank?

Ligon Gives Three Methods

N. J. DESCRIBES a problem of a leaky underground oil storage tank installed beneath a concrete floor inside a building. The oil soaked condition of the soil surrounding the tank makes repair by welding unsafe and to replace the tank would seriously disrupt production. N. J. describes his problem as a "mess," and I agree with him; however, there are three possible solutions.

Paint on Coating

I assume that there is a manhole into the tank from the plant building floor since N. J. stated that the tank is an old railroad tank car. In any event, by excavating down to the top of the tank and providing an entry into the tank after it has been emptied, it might be possible to seal the leaks by the use of a neoprene rubber coating or other oil resistant material that could be brushed or sprayed into the tank's interior surface sealing all joints, rivet heads, pinholes in tank wall, etc. There are several materials of this nature on the market, some of which may be better suited than others. The general method of surface preparation and application for most of them, are similar, usually consisting of: thorough cleaning to remove oil, followed by sand blasting to provide a suitable surface on which to apply the coating; a prime coat followed by two or more coats of the coating material should be applied immediately after sand blasting. It is usually advantageous to contract all work to an experienced company familiar with this sort of work. Although this is probably the cheapest manner in which the tank may be repaired the degree of success to be expected will depend on several factors, some of which can only be determined by a careful inspection of the tank's interior:

A. The tank wall should be basically "sound" — there should be no large "paper thin" areas resulting from excessive corrosion.

B. Present leaks should consist only of riveted joints, loose rivet heads, and small pin point holes in the tank wall resulting from external or internal pitting of the surface.

C. The temperature of the oil stored in the tank should not vary widely because unequal expansion of the tank at the riveted joints might continue to open up new cracks even after the present leaks are sealed.

Mr. N. J. does not mention the nature of the oil being stored. If this oil is high in sulphur content it may be possible that the presence of this corrosive oil in the surrounding earth has accelerated the corrosive attack on the tank. He will want to check this possibility.

Prefabricated Liner

Another very good solution (and although more expensive than No. I, it would not be subject to the limitations mentioned above) would be to install a prefabricated neoprene rubber or polyvinyl lining in the tank. This lining could be made in the form of a large bag or sack inserted through the manhole and cemented into place in the tank.

An alternate method of installation is to cement smaller sheets of the lining material (approximately $\frac{1}{8}$" thick) directly into the tank and vulcanize the seams together to form a seamless lining.

This type of lining should be serviceable as long as sufficient tank wall remains to support the mechanical loads imposed on the tank. Here again, the services of an experienced firm familiar with this work should be sought.

New Tank

The final alternative is to install a new storage tank, at a new location outside the plant building either above or below ground, pipe the oil into the plant and abandon the use of the existing leaky tank. A location should be chosen that would permit future tank maintenance when such becomes necessary. If N. J. elects to follow this possible solution and the new tank is to be installed underground he should take particular caution to see that the tank is coated externally with a corrosion resisting material and it may also be desirable to bury a magnesium or zinc anode near the tank for anodic protection.

If anodic protection is to be used the type of protective coating to be used on the tank surface should be carefully considered and the matter discussed with the corrosion engineers who represent the anode manufacturer.

Amarillo, Tex. CLEON LIGON

Line Tank With Synthetic Stone—Riley

CAUSES OF tank loss may be as follows:

1. Irregular distribution of soil particles and oxygen supply from point to point.

2. Chemical reactions of corrosive ingredients in the ground. Action of certain anaerobic bacteria, stray electric currents, etc.

3. The different stresses placed on tank plate due to strata movement and temperature changes.

Ninety-eight per cent of the buried storage tanks holding petroleum or hydro carbon fractions are lost from electrochemical reaction within the environment and not from internal corrosive attacks.

This means that as long as the tank remains buried it will continue to corrode unless, of course, properly protected against the attacks of soil acids, salts, oxygen and potential differences as may exist in the ground.

Tank replacement of this type is in most cases costly and at its best just a temporary replacement due to the corrosive conditions to which the metal is exposed. Repairs could increase the potential differences and speed up the corrosive rate.

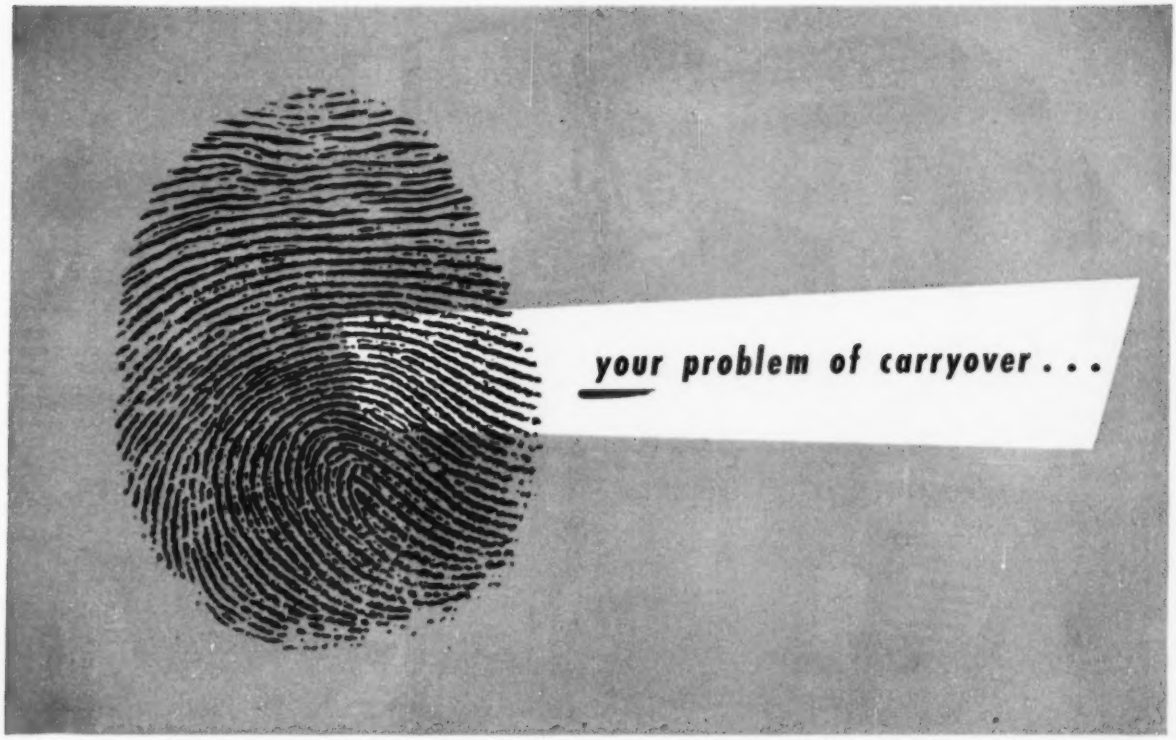
Specializing in the rehabilitation of underground storage vessels during the last 30 years, our case histories prove that where a stone tank is installed within the existing tank, regardless of condition, the customer still has a storage tank, even if, as we have found in many cases, the entire tank plate has rusted completely away.

The cost depends on working and water conditions. Each stone tank is serviced and maintained under a five year protective service contract, which protects the owner against repair or replacement within the limits of three times the installation cost.

Another outstanding feature of this protective service contract applicable to most storage tanks so lined, is the renewal privileges of the service, maintenance and protection against loss or repair for just a few cents per day after the five year period has expired.

Chicago, Illinois CHAS. J. RILEY

Editor's Note: Additional information on this liner is available on request to POWER ENGINEERING.



. . . is as individual as a fingerprint. No two problems are alike and there is no standard solution. However, with a comprehensive engineering approach and application of selected anti-foam agents, even an extremely difficult problem can be overcome.

To illustrate the point, a steel mill boilerhouse operating on 100% make-up water, produced 6,000,000 pounds of steam daily to operate its turboblowers. Continuous carryover of boiler water solids with steam was encountered. Regulators and valves were coated with heavy deposits. Frequent slugs of water passed through the superheaters into the turboblowers. And, the superheater temperature charts literally resembled a picket fence!

Betz Engineers recommended the application of proper anti-foam agents and effected a remarkable improvement. Carryover has been *eliminated*, and superheater temperature has been *increased* approximately 50 degrees.

Why not ask a Betz Engineer today to explain how anti-foam agents can help solve your own particular carryover problem and save you time, money and effort in your plant? Ask him too, about the complete Betz *Specialized* Water Conditioning Service tailor-made to your needs. W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Betz Technical Paper 115 "Carryover Prevention With Anti-Foam Agents" is free for the asking. Write for a copy today.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

For more data circle 541 on Post Card

It's a good thing for you that Mrs. MacTavish was on the school board

The plans for the new school building were all completed and were now being shown to the Board.

"And why," asked Mrs. MacTavish, "should the new building burn oil instead of coal?"

"Well," explained the architect very patiently, "oil saves labor."

"So does a stoker!" snapped Mrs. MacTavish.

"And oil is clean."

"No cleaner than coal if you use the right grade and burn it right. What's more, you can always get coal and maybe you can't get oil. Remember how the schools over at Jamestown had to shut down for weeks at a time during the war because they couldn't get oil?"

"Anything else, Mrs. MacT?"

"Indeed there is. I always save my big reason till the last. Coal's a sight cheaper."

"Oh now, Mrs. MacT., I don't think there is so much difference."

"When it comes to spending money, I don't want to think – I want to know. The Chesapeake and Ohio Railway has a combustion engineering service – absolutely free, mind you. Let's get their man to come in and give us facts – not opinions."

The C&O combustion engineer's carefully documented survey proved beyond doubt that coal would not only save several thousand dollars a year in fuel cost, but that the installation itself would be cheaper.

"There should be a Scot on every civic board," snapped Mrs. MacTavish. "We're the only people left who seem to care a hoot about the taxpayer's pocketbook."

Chesapeake and Ohio Railway

COAL...FUEL OF THE FUTURE

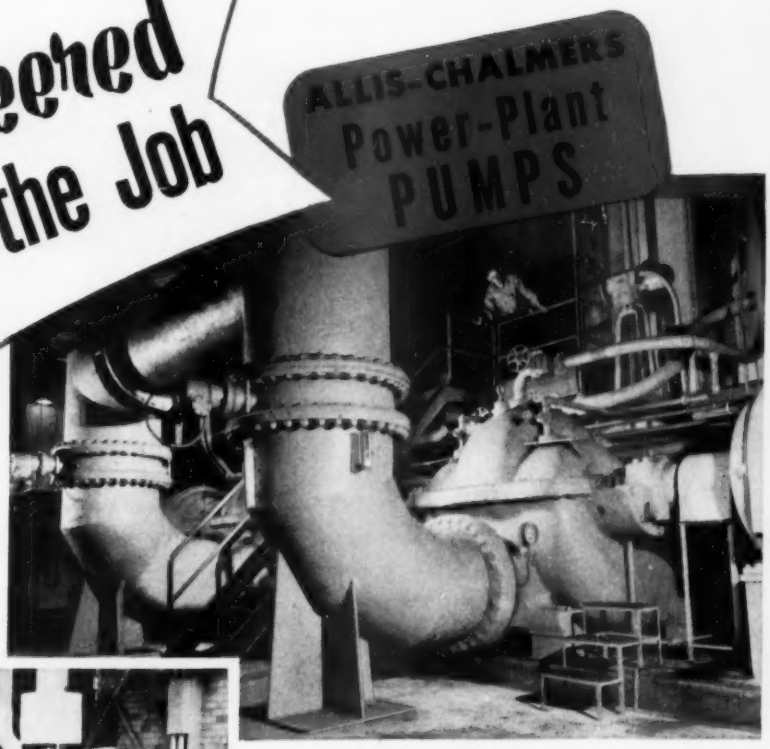
Bring your fuel problems to C & O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

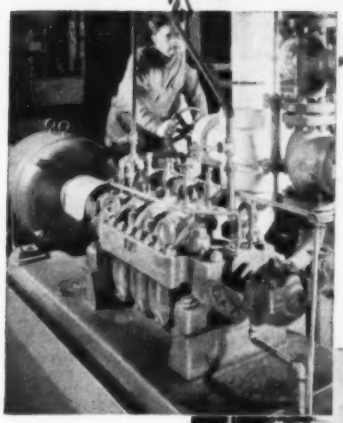
Write to:
Coal Traffic Department
Chesapeake and Ohio Railway
2116 Terminal Tower
Cleveland 1, Ohio

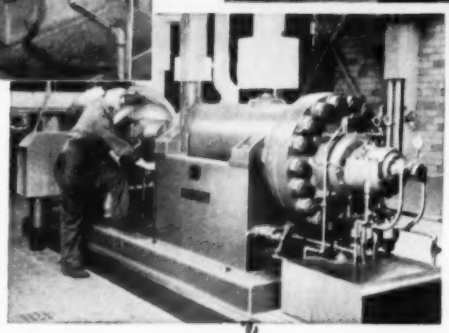
For more data circle 542 on Post Card

Engineered to Fit the Job

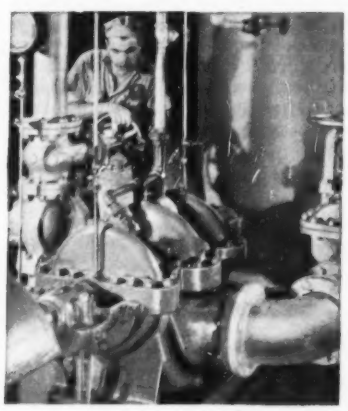


These double-suction centrifugal circulating water pumps are rated 35,000 gpm, 20-ft head. A-C also builds vertical axial and mixed flow types — providing a broad line that covers all installation requirements.





For boiler-feed service, Type M pumps provide heads up to 1200 psig. Barrel-type pumps offer high efficiencies in the pressure range of 1200 to 3000 psig, in ratings from 300 to 2500 gpm. Units shown are (above) 175 gpm, 1325-ft head and (right) 480 gpm, 4271-ft head.



Condensate pumps are designed and built for operating under vacuum and handling liquid at or near its boiling point. They are available in single and multi-stage types for vertical and horizontal mounting.

WHEN YOU TURN to Allis-Chalmers, you get triple insurance that each pump will fit your requirements:

(1) You gain application engineering based on more than 60 years of centrifugal pump experience and research . . . (2) You select from a wide, diversified line, with each pump custom-engineered for its specific job . . . (3) You get pumps that are individually tested, on the most modern test floor in the industry, to assure complete compliance with the specifications.

This triple insurance can cover all of your major pump requirements . . . from high-pressure boiler-feed units to solids-handling ash sluice pumps . . . horizontal or vertical . . . centrifugal, mixed or axial-flow types. You gain by calling in your A-C representative for help.

WRITE FOR *Bulletin 52B6059, listing Allis-Chalmers pump types and ratings.*

A-41418

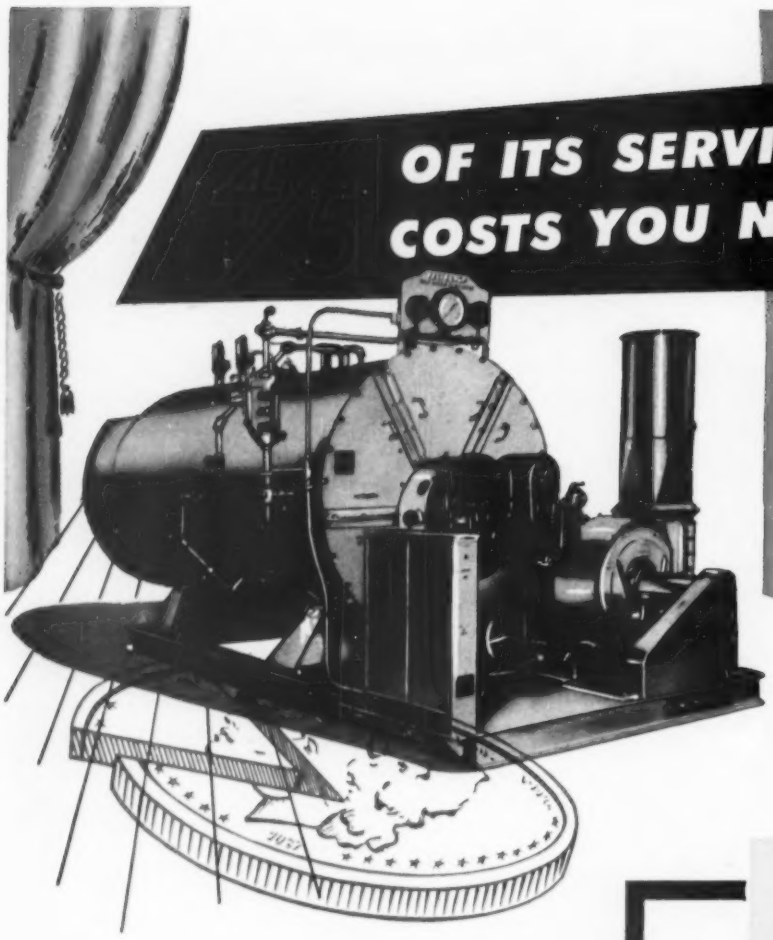
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Milwaukee 1, Wisconsin

For more data circle 543 on Post Card

OF ITS SERVICE LIFE COSTS YOU NOTHING!



PREFERRED
Unit
Steam Generator

Preferred Unit Steam Generators are available in sizes from 20 to 600 B.H.P. and pressures from 15 to 250 psi, to burn oil or gas or in combination. All units are factory fire-tested before shipment.

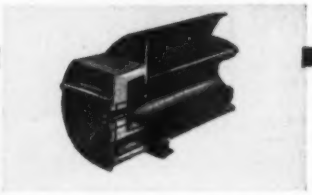
The economies realized in sustained efficiency, fuel consumption and over-all maintenance and operating costs combine to make the Preferred Unit Steam Generator pay for itself in *less* than five years, amortization included. For more than four-fifths of its service life of at least twenty-five years it earns handsome dividends while it continues to deliver steam at the lowest possible over-all cost.

TEN DESIGN FEATURES MAKE THIS POSSIBLE

There are ten outstanding design features incorporated in each Preferred Unit. No other packaged boiler has *all ten* of these features. Their interrelated functions insure steam generation at the lowest possible cost by cutting maintenance costs of all kinds to the bone and by reducing fuel consumption by at least 10%.

STUDY THESE FEATURES IN CATALOG 2000

The function of each of these features in relation to the others and to the unit as a whole is covered in Catalog 2000. It shows why Preferred units pay such a worthwhile return on the investment. Write for it now.



PREFERRED'S ANTI-STRESS DECK

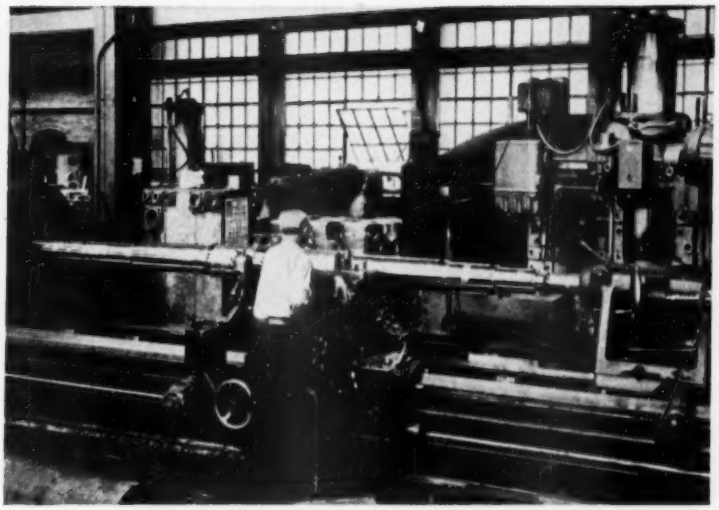
Prevents damage in the sheet area by maintaining the sections of the rear tube sheet above and below the water line in close balance. Unequal stress action is eliminated. The Anti-Stress Deck is one of the ten design features which insure long service life and low over-all maintenance and operating costs. Here are the other nine...

- Five Sq. Ft. of Heating Surface per Boiler HP
- Four Pass Gas Travel
- Down Draft Design
- Induced Draft
- Intermediate Furnace Position
- Expansile Precipitator
- Staggered Tubes
- Dual Purging Action
- Full Automatic Oil and/or Gas Burners

PREFERRED UTILITIES MFG. CORP.
1860 BROADWAY, NEW YORK 23, N. Y.
DEPT. PE-1

For more data circle 544 on Post Card

When you need a tough, fatigue- and corrosion-resisting alloy —try "K" Monel



This is one of the largest INCO Nickel Alloy pump shafts in the world. The shaft is 13 feet 7⅛ inches long, 9.005 inches at its widest diameter, and weighs 3,343 lbs. It was forged by INCO'S Huntington Mill from "K" Monel for Consolidated Edison Co., after other materials repeatedly failed.

Are there applications in your operation where metal is subject to fatigue, corrosion and erosion?

Then chances are "K" Monel is the alloy you need.

"K" Monel is a tough, corrosion-resisting wrought alloy of nickel, copper and aluminum. It offers you the excellent corrosion resistance of regular Monel, together with the added advantages of greater stiffness and hardness through heat-treating.

As evidence of the value of "K" Monel's added advantages, take a pump shaft operating in highly corrosive and polluted salt water.

New York City's Consolidated Edison Company has two big 80,000-gallon-per-minute condenser circulating water pumps. For years engineers kept replacing the shafts with materials of increasing strength but failures would continue to occur in the same spot because of corrosion fatigue.

Finally, they decided to try "K" Monel.

A 1½-ton heat-treated "K" Monel shaft with a tensile strength of 140,000 pounds per square inch was installed in September of 1949 and has been functioning perfectly ever since. In fact, the pump casing has not even been opened for inspection since installation.

Let's take a quick look at a few of the principal characteristics of "K" Monel:

Age-hardenable, or capable of having its hardness and mechanical properties increased simultaneously as the result of thermal treatment, "K" Monel is equal in strength and toughness to many heat-treated alloy steels. It shows improved strength and hardness at sub-zero temperatures with no loss of toughness. And it provides moderate strength at temperatures up to 900° F.

"K" Monel is non-magnetic under ordinary conditions, and remains so down to −150° F.

The working characteristics of "K" Monel are excellent, too. It is readily machined in an annealed condition, but in other conditions may be considered commercially machinable at practical (although generally somewhat slower) rates. It can be joined by the usual welding, brazing and soldering processes.

You'll find all essential engineering data on "K" Monel and its more machinable companion alloy, "KR" Monel, in the 24-page reference manual, "Engineering Properties of 'K' Monel and 'KR' Monel." Write for a copy so you'll have one handy when you need it. And any time you want help in solving a metal problem, get in touch with Inco's Technical Service Section.

The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

INCO

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • INCONEL® INCONEL "X"® • INCONEL "W"® • INCOLOY® NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL DURANICKEL®

For more data circle 545 on Post Card

Be Sure

OF DEPENDABLE, SAFE SERVICE
SPECIFY

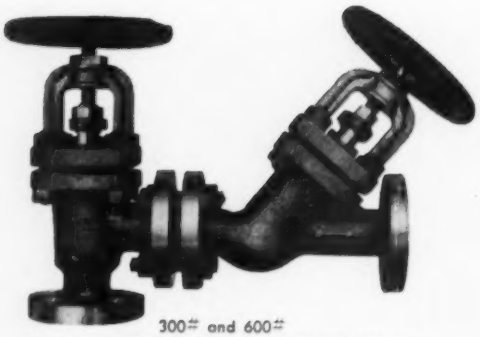
HANCOCK Blow-Off VALVES

Hancock Blow-Off Valves provide completely reliable and safe performance in the severest services—surpass all land and marine codes and insurance provisions. They are modern valves, backed by more than 50 years of experience with the rigid operation and maintenance requirements of steam generating equipment.

Carefully selected materials of the highest quality are used to the best functional advantage to decimate wear . . . to eliminate all non-essential weight . . . to reduce overall dimensions . . . to assure easy, low-cost installation. Because they are simply designed and engineered Hancock Blow-Off Valves have a minimum number of parts—maintenance costs are negligible. Operation is smooth, efficient—you get superior performance regardless of the demands of the installation.

Whatever your boiler blow-off or water treatment practices, remember the best cost no more. Hancock Blow-Off Valves are preferred by far more design and operating engineers than any other make. So—whether you have a revalve project or are contracting for new steam generating equipment—specify Hancock Blow-Off Valves.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Long experience in serving industry makes him fully qualified to meet your valve needs exactly and economically. Call on him for expert counsel and prompt delivery from local stocks.



300# and 600#

HANCOCK "BLO-DEFLECTOR" BLOW-OFF VALVES

Outside Screw and Yoke

Sizes: 1½", 2" and 2½".

Types: Straightway and Angle.

Connections: 300#—Flanged or Screwed Ends; 600#—Flanged or Socket Weld Ends.

Pressures at 800° F.: 300 psi, 416# Maximum Boiler Pressure—Flanged Ends; 515# Maximum Boiler Pressure—Screwed Ends. 600 psi, 785# Maximum Boiler Pressure—Flanged Ends; 950# Maximum Boiler Pressure—Socket Weld Ends.

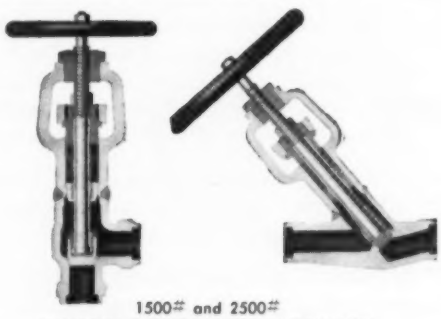
Body: Cast Carbon Steel.

Seat: Integral. Has Cobalt Chromium Tungsten Alloy Facing.

Disc: 500 Brinell Stainless Steel.

Outstanding Features

1. No body and seat joints—seat stays tight. Cost of parts and repairs reduced—seat will last the life of the valve.
2. Simple, rugged design—only 18 different parts, including nuts and bolts. "Blo-Deflector" seat and disc design makes it impossible for the velocity of the water to cut the seating surface of the disc.
3. Easy operation: No more hand power required than for ordinary stop valves. Flexible: Valve can be opened fast or slow as desired. Full hand turning power always available to close valve tightly.
4. Saves BTU's and treated boiler water through seat and disc tightness.
5. No separate so-called "quick opening" valves needed. Minimum of different parts required for tandem installation.



1500# and 2500#

HANCOCK STEEL BLOW-OFF WELDVALVES

Outside Screw and Yoke

Sizes: 1", 1½", 2", and 2½".

Types: Straightway and Angle.

Connections: Socket Weld Ends standard. Flanged if required.

Pressures at 1050° F.: 1500 psi, 2080# Maximum Boiler Pressure. 2500 psi, 3120# Maximum Boiler Pressure.

Body: Chrome Molybdenum Steel.

Seat: Integral. Has Cobalt Chromium Tungsten Alloy Facing.

Disc: 18-8 Stainless Steel with Cobalt Chromium Tungsten Alloy Facing.

Outstanding Features

1. No bonnet or body joints to leak, no gasket to blow.
2. No seat joints—cutting of threads between body and seat eliminated. Seat can be inspected and serviced while valve is in the line, without cutting the bonnet weld.
3. Compact—diameter and height greatly reduced. Lines can be installed closer to drums, columns and structures.
4. No bulky yoke flanges—lagging and pipe hanger costs greatly reduced.
5. 50% or more reduction in weight makes handling far easier during installation.

When Hancocks go in, valve costs go down

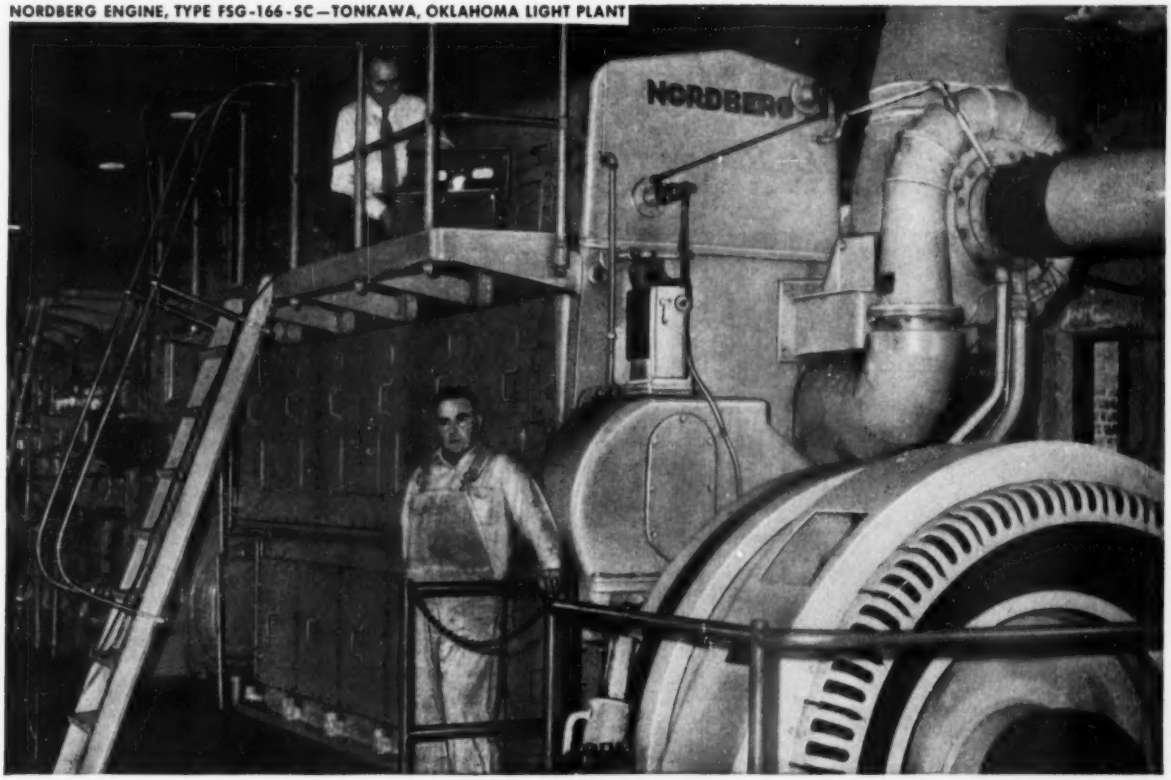
HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 546 on Post Card

NORDBERG ENGINE, TYPE FSG-166-SC—TONKAWA, OKLAHOMA LIGHT PLANT



30,000 HOURS, NO WEAR!

MICROMETER MEASUREMENTS			
LINER MEASUREMENTS		WITH CRANK	90° TO CRANK
#1 Liner	Top	16.004"	16.008"
	4" down	.003"	.006"
	8" down	.0035"	.007"
#2 Liner	Top	16.003"	16.002"
	4" down	.002"	.001"
	8" down	.001"	.0005"
#3 Liner	Top	16.005"	16.007"
	4" down	.004"	.006"
	8" down	.003"	.008"
#4 Liner	Top	16.003"	16.004"
	4" down	.004"	.005"
	8" down	.001"	.002"
#5 Liner	Top	16.004"	16.000"
	4" down	.003"	.000"
	8" down	.003"	.001"
#6 Liner	Top	16.003"	16.0015"
	4" down	.0015"	.0015"
	8" down	.0015"	.0005"
(Original machine shop tolerance—16" plus or minus .001")			

No Wear On Rings Or Liners With Great Cities Service Diesel Oils!

When the Tonkawa City people pulled this Diesel off the line for periodical inspection, it had logged 30,038 hours and was approximately six years old. After they had the engine torn down, micrometer measurements were taken on the cylinder liners. THEY COULD FIND VIRTUALLY NO APPRECIABLE WEAR ON RINGS OR LINERS!

They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

For more data circle 547 on Post Card

Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years

Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

What its advantages are: J-M Service Sheet is a quality packing, made of selected long-fibre asbestos bonded with heat-resisting compounds. It is graphited on one side to permit breaking a joint without destroying the gasket. The ungraphited side is ruled into one-inch squares to speed cutting and reduce waste. And . . . you can order it in large economical quantities because J-M Service Sheet will not dry out in stock!

How it is furnished: Service Sheet is supplied in sheets 54″ x 63″, 36″ x 126″, 36″ x 63″, and 54″ x 126″ sheets in thicknesses of 1/64″ to ¼″ and 108″ x 126″ sheets in thicknesses of 1/32″ to ¼″. It is also furnished as cut gaskets in standard and special shapes. See the J-M catalog for further details.

Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

For more data circle 548 on Post Card

Pacific BOILER FEED PUMPS

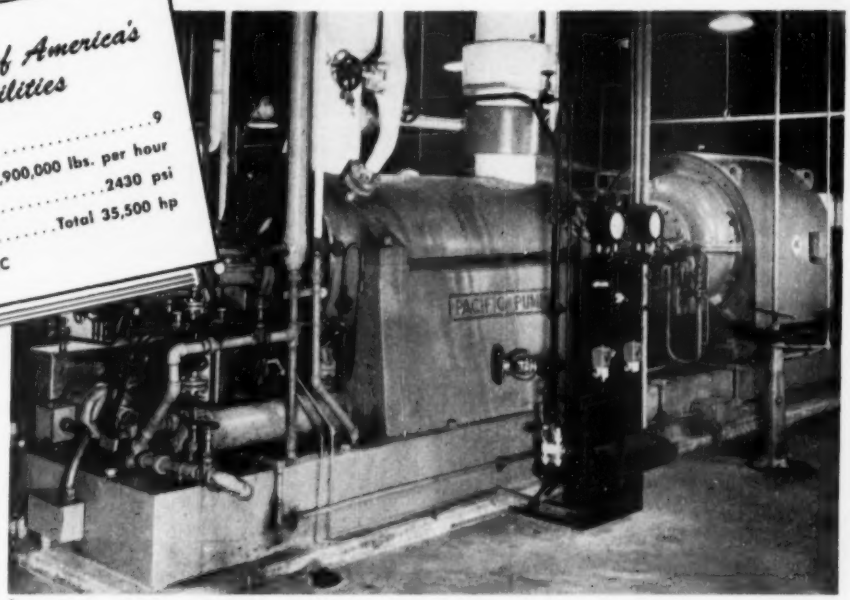
are Custom-Built to your specifications

Write your own "prescription":

Rx

NAME: *One of America's largest Utilities*

NUMBER OF PUMPS.....9
CAPACITY.....Total 7,900,000 lbs. per hour
DISCHARGE PRESSURES.....2430 psi
ELECTRIC MOTOR DRIVE.....Total 35,500 hp
CUSTOM-BUILT BY PACIFIC



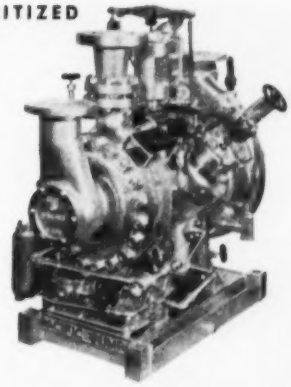
Pacific Boiler Feed Pumps are fabricated from selected materials to provide the utmost structural strength and stability – maximum resistance to corrosion-erosion and wear. Built in multi-stages for capacities to 2700 gpm; discharge pressures to 3000 psig; speeds to 5000 rpm.

Pacific SINGLE STAGE UNITIZED STEAM TURBO PUMPS

less unit cost–
less floor space–
steady dependable output!

Capacities to 500 gpm
Discharge Pressures to 1100 psi
Steam to 900 psi – 850°F. TT
Exhaust Pressures to 50 psi
Speeds to 10,000 rpm

Write for bulletins 109 and 118



PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

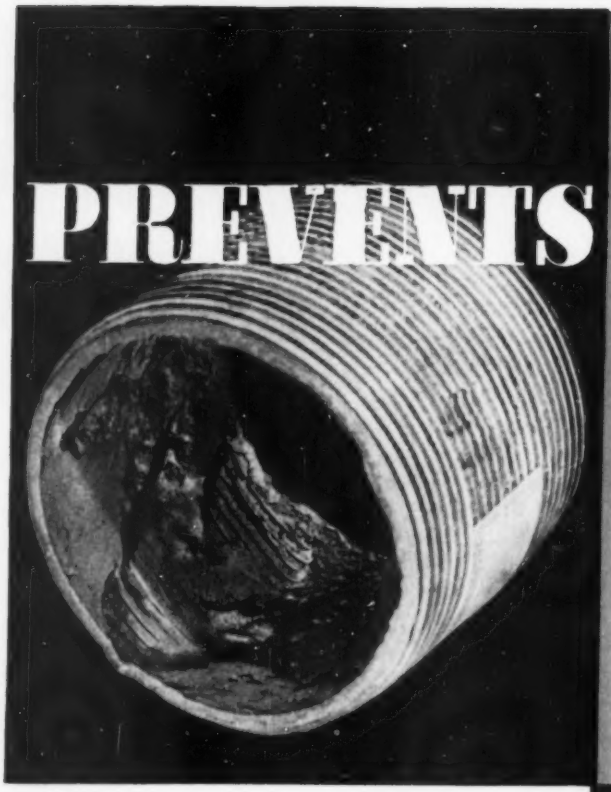
HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York • *Offices in All Principal Cities*

For more data circle 549 on Post Card

Dearborn FILMEEN PREVENTS

TRADEMARK



RETURN LINE CORROSION

You may have seen this many times . . . pipe and fittings eaten through by corrosion. The line must be taken out of service and replaced, causing costly maintenance and production loss.

Dearborn Filmeen* prevents such destruction with a protective film that coats the interior surfaces to prevent corrosion. Minute quantities of Filmeen establish and maintain this protective film throughout the system. Because of its dispersible characteristics, Filmeen will penetrate to every part of the steam and condensate system. Also, Filmeen is non-toxic and, when used as recommended, can be safely applied where steam comes in direct contact with food or where steam is used for sterilization. Write for Bulletin 5013-A. *Pat. No. Re-23614*

Dearborn 659** Sludge Conditioner

The most important development in sludge conditioning is Dearborn Formula 659. This treatment conditions sludge to a fluid, non-adherent form readily removed by blowdown—protects against scale formations in water feeding systems—eliminates corrosion in feedwater systems and boilers. Formula 659, furnished in powder or briquette form, also contains Dearborn's patented Polyamide stabilizing agent which assures high purity steam. Write for Bulletin 5008-B. ***Pat. No. Re-23085*

Untreated sludge **settles into a compact mass causing sludge and scale deposits. Note how sludge adheres to glass.**

Treated sludge **produces fluid, non-adherent particles which readily disperse to prevent packing and attachment.**

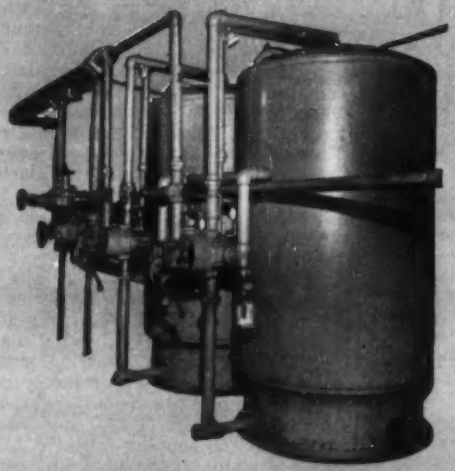
Dearborn

TRADE MARK

COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

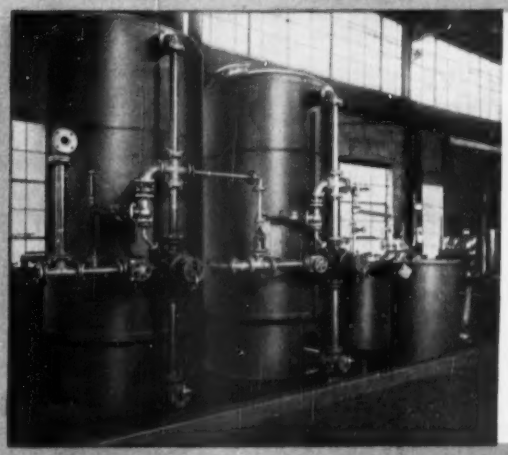
Dearborn OFFERS A COMPLETE WATER CONDITIONING AND ENGINEERING SERVICE



Whether you require a manual, semi-automatic or completely automatic system, Dearborn gives you a customized program including (1) the initial plant survey; (2) external and internal treatment recommendations; (3) properly designed feeding equipment; and (4) supervisory service. Here, from a single source, you have all the facilities for maximum efficiency and economical performance in your water conditioning operations.

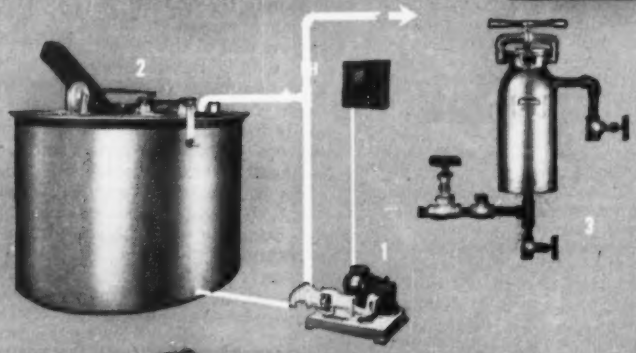
ZEOLITE SOFTENERS

A Dearborn installed 500,000-gallon Zeolite water softener for the treatment of boiler water makeup.



DE-IONIZING PLANTS

This Dearborn 2-bed De-Ionizing unit is capable of producing 75,000 gallons of demineralized water per day. Piped throughout with Saran-lined steel. Includes corrosion-resistant ejectors, rubber-lined tanks and valves. On special applications where mineral-free water is required, a Dearborn De-Ionizing plant will reduce the mineral content of water to the equivalent of that produced by evaporation . . . and at a much lower cost. Write for Bulletin 5005.



INTERNAL TREATMENT

(1) High-pressure pump, (2) hand-agitated chemical tank for delivering treatment directly into the boiler drum, (3) Type H feeder for manual application of either briquette or powdered treatments. Write for Bulletin 5000.

why you can rely on Dearborn

Dearborn has specialized in the conditioning of water and the control of corrosion since 1887. This broad experience in water treatment and rust prevention—plus Dearborn's extensive laboratory and research facilities—are at your service . . . at no obligation. You'll find it will pay you to . . .

know your Dearborn engineer

For more data circle 551 on Post Card

IMPROVED OPERATION OF LITERALLY HUNDREDS OF MECHANICAL PRODUCTS HAS BEEN EFFECTED WITH ACCO TRU-LAY FLEXIBLE *PUSH-PULL* CONTROLS

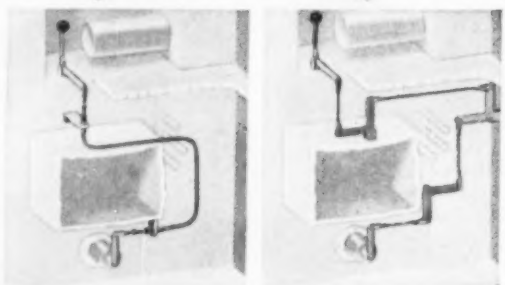
If you would like more information, after reading this brief summary of the characteristics and widespread use of this versatile Remote Control, just ask us to send you our **IDEA FILE** with complete Application Data.

Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electrical, Hydraulic and Air Controls.

• • • • •

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts . . .

to give you this simple and effective assembly . . . **rather than this complex (and expensive) series of linkages**



POSITIVE REMOTE-ACTION and FLEXIBILITY

together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

Lubrication of the inner working member is taken care of for life.

Temperatures as low as −70° F. will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

It is more than likely that you will find ACCO TRU-LAY *Flexible* PUSH-PULL CONTROLS doing a good job on some or many of the products used in your own business . . . on your drinking fountains, business machines, factory lift trucks (gas or electric) to control tilt and lift, or in your power or heating plant, perhaps controlling the pitch of blades on a big exhaust fan. The full list of applications is simply tremendous.

Send for this IDEA FILE *This* **IDEA FILE** *will answer most of the questions you may have in mind as to how you might make additional applications of this versatile and dependable tool. Write for a copy, without obligation.*

NEW IDEAS

ACCO

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

601 Stephenson Bldg., Detroit 2
2216 South Garfield Ave., Los Angeles 22 • Bridgeport 2, Conn.

For more data circle 552 on Post Card

Automatically Regulated Capacitance

continued from page 61

would be placed as close together as possible in order to reduce reactance, two advantages can be gained by spacing them farther apart when power factor regulating equipment is used — greater insulation for the line, and lower cost for the regulating equipment. In some cases, it might even be economical to install reactors in the line. This method would encourage the use of high speed operation where it is desirable to place a large amount of capacity across the line in a short space of time, as, for instance, when large motors are being started.

Changing the regulating taps on the supply transformer in order to compensate for the greater line drop with increasing loads would in many cases be eliminated, since the action of the automatic power factor correction apparatus would make the receiving voltage on a feeder nearly equal to the sending voltage. Likewise, the objectionable variable sending voltage obtained with ordinary regulating equipment would be eliminated and flat voltage at one end of a feeder would not be sacrificed to provide the same characteristic at the other end. Hence, power factor regulation promises improved service for power consumers at both ends of a feeder.

Where it is desired not to have the regulating equipment operate on every fluctuation in load conditions, a definite time relay can be introduced so as to hold the control circuit open for a given time after a change occurs; then, if the change is not sustained, the control equipment does not operate.

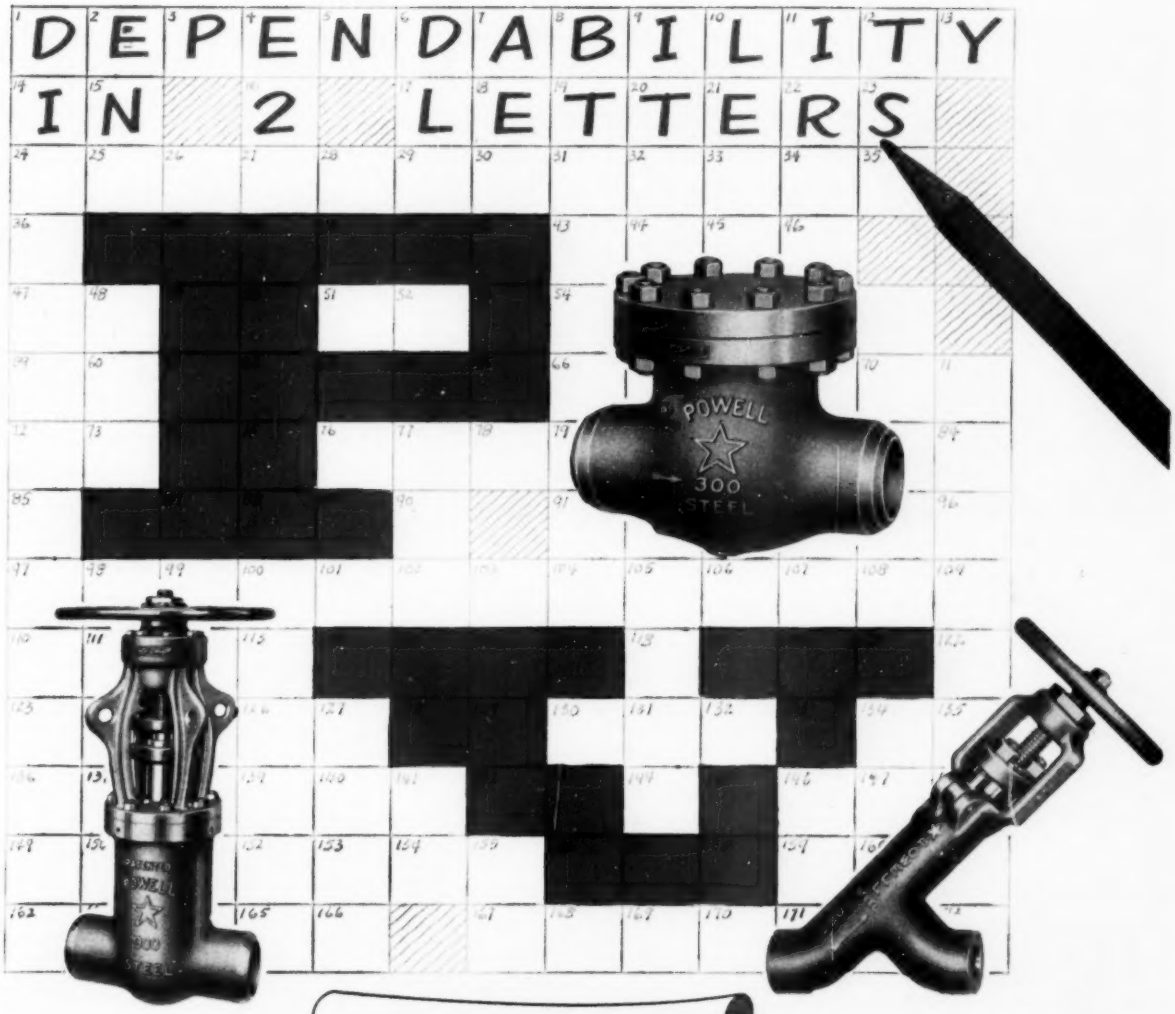
Where the no load voltage is likely to reach excessive values on the receiving end of the feeder, as when the line would be de-energized at full load and later re-energized with no load connected, provision can be made for running the regulator back to zero before the contactors begin to close.

By the use of a "forcing" arrangement, the complete bank of capacitors can be made to be placed almost instantaneously across the line when excessively low power factors occur. This would be useful where large motors have to be started.

Regulation Methods Compared

In any method of voltage regulation, the line losses are increased when constant voltage is maintained at a receiving point. Conventional voltage regulating equipment has nearly always been employed to greatest advantage at the sending end of a feeder.

Line losses are reduced by virtue of the higher transmission voltage produced by a voltage regulator operating with line drop compensation;



TOP

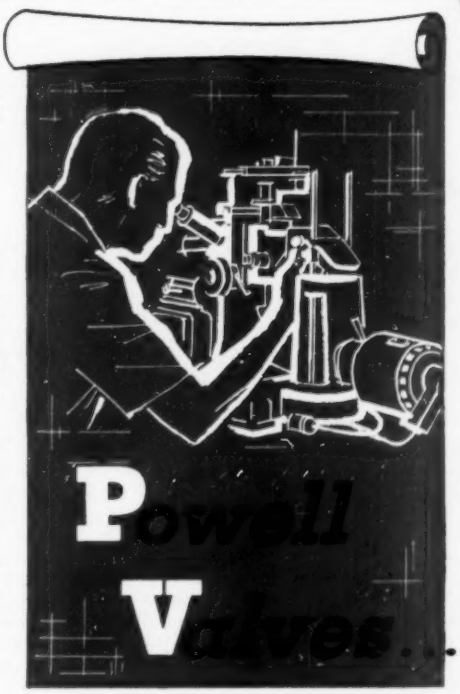
WELDING END CAST STEEL SWING CHECK VALVE *(Fig. 3061WE)* 300 pounds. Bolted flanged cap. Heavy rugged construction. Available in sizes 1" to 12", inclusive.

LEFT

WELDING END PRESSURE SEAL CAST STEEL GATE VALVE *(Fig. 19003WE)* 900-pound. Many proven advantages and exclusive features. Powell Pressure Seal Valves are available in Non-Return, Check, Globe, and Angle Patterns, 600 to 2500 pounds, inclusive.

RIGHT

INTEGRAL BONNET CAST STEEL "Y" VALVE *(Fig. 1314-A)* 1500-pound. Socket Weld Ends. The one-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive. Also available for 2500 pounds.



The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

All good reasons why PV, for Powell Valves, appears on more specifications year after year.

THE WILLIAM POWELL COMPANY
CINCINNATI 22, OHIO

CONTROLS FOR THE LIFE LINES OF INDUSTRY

108th YEAR

For more data circle 553 on Post Card

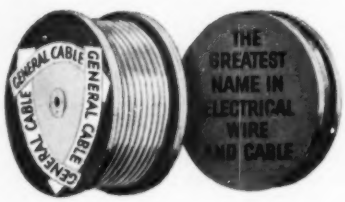
GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

To wire a plant or wind a coil

IT PAYS TO BUY IN ONE PLACE!

Actually there is only one source for all of the types of wire and cable you may need...that's General Cable. To meet your every requirement, General Cable manufactures bare, weatherproof and insulated conductors of every variety ...maintains vast stocks...the broadest distribution facilities in the industry...ultra-modern plants coast to coast. Specify "General Cable." Don't settle for less.



GENERAL CABLE CORPORATION 420 Lexington Avenue, New York 17, New York

Sales Offices: Atlanta • Buffalo • Cambridge (Mass.) • Chicago • Cincinnati • Cleveland • Dallas • Detroit Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • Minneapolis • Newark (N. J.) • New York • Philadelphia Pittsburgh • Portland (Ore.) • St. Louis • San Francisco • Seattle • Syracuse • Tulsa • Washington, D. C.

For more data circle 554 on Post Card

that is, the kva of the feeder is increased by raising the voltage. If such a regulator were located at the receiving end, the kva would be increased by the increased current; hence, since losses vary as the square of the current, the proper position for the conventional feeder voltage regulator is at the sending end.

Voltage regulation by means of capacitors naturally makes the receiving end the preferable location, since the principle of operation is the reduction of lagging current flowing through an inductive line. Such regulation, of course, requires additional capacity in the power factor corrective equipment.

Line Losses

The kw loss in a capacitor is approximately 0.2 per cent, or less, of the kva input to the capacitor, although automatic regulation further reduces losses in a system by removing capacitor kva from service when it is not needed. Since the kva capacity of a capacitor varies with the square of the applied voltage, it is often a great saving in first cost to provide step-up transformers and high voltage capacitors when power factor correction is desired on low voltage circuits. The full load losses of such transformers are about 1.5 to 2 per cent, and automatic regulation reduces this as well as capacitor loss by reducing the load on the transformers. Figure 5 shows the line losses for circuit in the following worked example when using normal voltage regulation at the sending end (regulation by generator field or transformer ratio or otherwise) compared with regulation by capacitance at the receiving end.

Feed Pump Bearings

continued from page 91

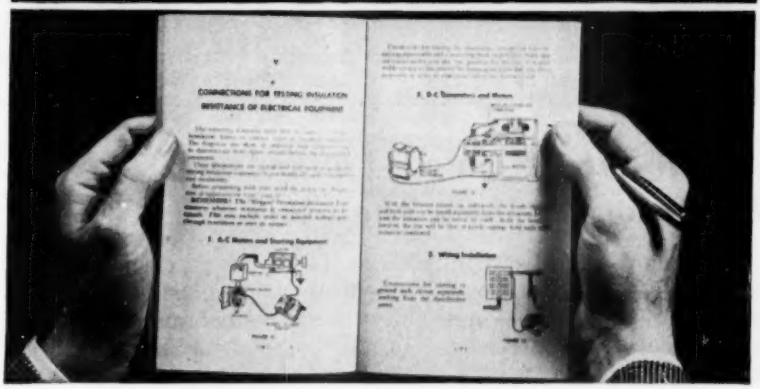
available, it is possible to drive a bearing on a shaft by hammering alternately on opposite sides of a tubular sleeve held against the inner race, as in Fig. 3. In forcing a bearing on a shaft, care must be exercised so that the bearing race is never cocked at any time; but the most important caution is that pressure should never be exerted on the outer race (as illustrated on Fig. 4), as this is the surest way to ruin a bearing.

After the bearing has been mounted, its position should be checked with a feeler gage to make sure it is pressing against the shaft shoulder.

Sleeve Bearings

If the pump is fitted with babbitted sleeve bearings, the clearance between the shaft and bearing bushings should not be allowed to exceed 150 per cent of the original clearance. While babbit bearings can be restored by metal spraying, the procedure is somewhat hazardous and if field repairs are necessary, it is preferable to rebabbit by pouring, using an undersize shaft as a core. The

BIDDLE *Instrument News*



MEGGER® MANUAL

Tells You How To Test ELECTRICAL INSULATION

40,000 Copies Have Been Distributed

This 94 page manual is in demand by educators as well as practical electrical men. It covers subjects of necessity to anyone who is responsible for electrical equipment.

"Why Test Insulation Resistance?"
"Preparation of Apparatus for Test"
"Tests When Drying Out Wet Apparatus"
"Temperature Correction"
"Methods and Interpretation"

These are but a few of the 14 chapters that are built around the subject of testing electrical insulation resistance . . . and, of course, effective use of the Megger® Electrical Insulation Resistance Tester sold in the U. S. only by the James G. Biddle Co. Supply is limited. Please write on your company letterhead for **INSTRUCTION MANUAL 21-J-PE.**

ELECTRICAL PREVENTIVE MAINTENANCE MATERIAL

Written by Practical Electrical Men

BULLETIN 21P8—"The Story of Electrical Insulation Resistance"

BULLETIN 21P9—"Maintenance of Industrial Electrical Equipment"

BULLETIN 21P10—"Cut Electrical Breakdowns"

BULLETIN 21P11—"Getting the Most From Insulation Resistance Measurements"

BULLETIN 21P12—"Preventive Maintenance of Electrical Equipment"

BULLETIN 21P16—"Motor Maintenance with a Check Chart for Alternating- and Direct-Current Motors"

You can tell from Megger Insulation Tester readings if insulation is going bad before it breaks down. Periodic readings provide the means for keeping your finger on the pulse of your electrical equipment, saves time and repair bills.

YOU MAY HAVE ONE OR ALL WITHOUT CHARGE

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

JAMES G. BIDDLE CO. B-907 PE
1316 Arch St., Philadelphia 7, Pa.

Please mail me: ☐ Bulletin 21P8 ☐ Bulletin 21P9 ☐ Bulletin 21P10 ☐ Bulletin 21P11 ☐ Bulletin 21P12 ☐ Bulletin 21P16

*Name*_____

*Job*_____

*Company*_____

*Address*_____

For more data circle 555 on Post Card

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 | FEBRUARY 1954 | Number 1

Amine Film Reduces Condensate Corrosion by More Than 90%

In a plant manufacturing electrical equipment, carbon dioxide and oxygen in the steam condensate were causing numerous piping failures. Corrosion products plugged lines and caused poor space heating by depositing in the heaters and by interfering with trap operation.

The Hall field service engineer recommended that the film-forming corrosion inhibitor Hagafilm* be fed to the boilers for distribution throughout the return system.

Treatment was started during the cold season and by spring all old deposits were cleaned out of the lines and failures were negligible. Test specimens showed a corrosion reduction of 91 and 92 percent at two locations. Weekend overtime work on the return system was eliminated. Trap maintenance was reduced to practically nothing whereas formerly a man had to be kept constantly on that job. Complaints, which had been commonplace before, disappeared as space heating improved. Substantial savings in equipment and manpower were achieved at moderate cost.

The next year, at the end of the first full cold season with treatment, it was reported that considerably less coal was used than during the previous year. There had been no other changes in operation and the weather was comparable.

During the second full cold season over two years after the start of treatment, the plant reported the only failures were two nipples and one tee which had been installed before the start of inhibitor treatment.

*Hagafilm is a registered trademark.

Water is your industry's most important raw material. Use it wisely.

Hall Engineer "Sees Through" Glass Problem

In this glass factory, maintenance costs were running as high as $75,000 annually. Critical were watercooled "gathering rams," the working ends of which were almost continuously exposed to furnace temperatures of 2,800° to 3,000° F. Deposits and corrosion in the cooling passages had led to overheating and failure.

An investigation by the Hall field service engineer revealed that cooling water flow through the rams was mechanically restricted in places, and that the water feed and discharge lines were poorly arranged and insulated.

Once these defects were corrected, Threshold treatment of cooling water with a few ppm of glassy phosphate proved effective in controlling deposition and corrosion. Now the plant engineer says, "We have forgotten about cooling water altogether."

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, P.O. Box 1346, Pittsburgh 30, Pa.

Hall Field Engineers "Refreshed" in Pittsburgh

Hall field engineers recently spent a week in Pittsburgh attending an annual refresher course. Twenty sessions were devoted to discussions of the latest technological advances in the field of water conditioning and the engineering solution of specific water problems.

A major purpose of the course was to provide an exchange of information regarding actual situations encountered by Hall field engineers in many different types of industrial plants.

Conductivity Tests Streamlined With New Flow Cell

Hall research engineers have simplified testing for dissolved solids in an eastern utility plant's condensate and feedwater system by development of a new flow cell used in conjunction with an electrical conductivity meter. The compact unit is less than 10" long, and the cell itself is so small that there is practically no holdup to level out differences in conductivity.

One of the advantages evident in use is the ease of removal and installation of the conductivity cell when cleaning or inspection is required. The operator takes the assembly apart quickly and easily because of a specially designed flexible coupling with rubber "O" rings and back-off nuts. A bimetallic dial-reading thermometer is a standard part of the assembly. Aside from the glass cell itself, the principal "wet" components are made of stainless steel.

bearings are then bored almost to size and final scraping is used to restore the correct dimensions. Care should be taken to locate the oil grooves so as to obtain correct oil distribution.

Kingsbury type thrust bearings should be reconditioned with great care, following the manufacturer's instructions. In most cases, it is not wise to attempt to restore the parts and it is best to replace worn parts from the stock of spares.

OBITUARIES

Leroy F. Harza

LEROY F. HARZA, one of the leading figures in hydroelectric and river control developments not only in this country but all over the world, died at his home in Highland Park, Ill., November 22, 1953. He was 71 years old.

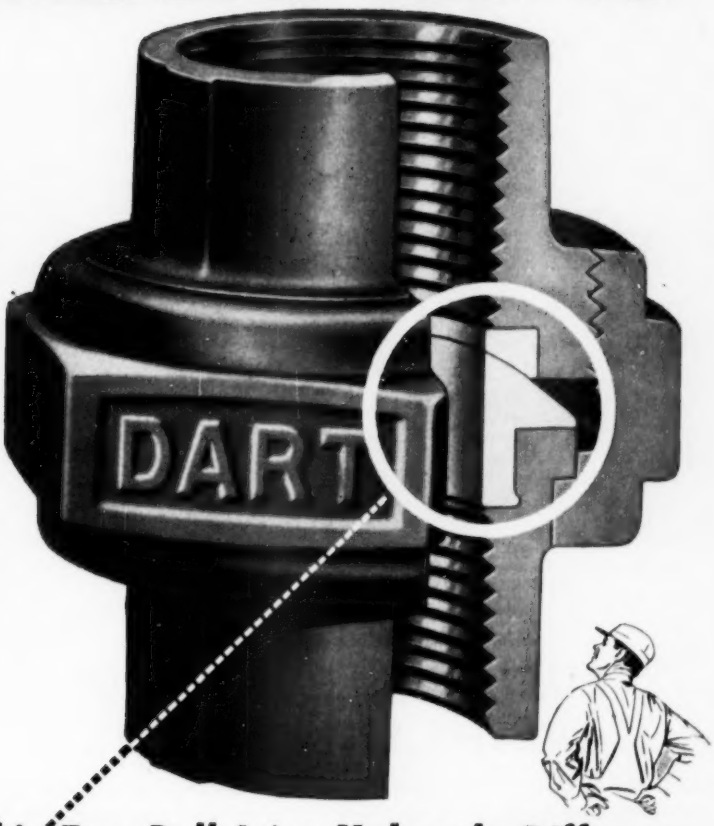
Mr. Harza had been head of his present consulting firm, Harza Engineering Co. in Chicago, since 1920. But his active practice began in 1906 when for six years he was chief designer for Daniel W. Mead, famous hydraulic consultant of Madison, Wis. Before that, Mr. Harza had received an ME degree from South Dakota State College in 1901, taught mathematics for two years at Michigan State College, then earned professional degrees in civil engineering at the University of Wisconsin.

Active in his profession almost to the day of his death, his consulting engineering career of nearly half a century had made him the dean of American hydraulic engineers.

Many of the world's notable hydropower installations were the products of his seasoned judgment and originality of thought. During 1912–16, Mr. Harza had his own consulting office in Portland, Ore., which did much of the pioneer work on such currently important projects as The

Dart Unions are

LEAKPROOF



This True Ball Joint Makes the Difference

You can't buy an *easier*-operating, *longer*-operating, more *positive*-operating union for *any* money

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Extra wide bronze seats (Resist pitting and corrosion)
- Heavy shoulders (Take severe wrenching without harm)
- Nut and Body Practically Indestructible (They're air-refined, high test malleable iron)

See your supplier today

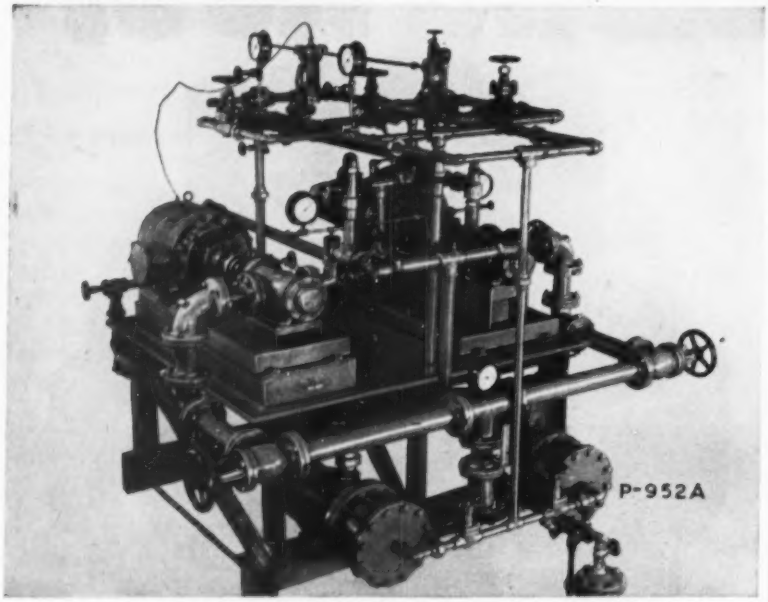
DART UNIONS

DART UNION COMPANY • PROVIDENCE 5, RHODE ISLAND

The Fairbanks Co. — Distributors: Boston • New York • Pittsburgh • Rome, Ga.

For more data circle 557 on Post Card

Now!
MORE COMPACT THAN EVER . .



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-E52H size No. 25 unit.

NATIONAL AIROIL
FUEL OIL PUMPING *AND* HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40 — very interesting and informative.

- OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
- STEAM ATOMIZING OIL BURNERS
- SLUDGE BURNERS, Steam Atomizing
- MOTOR-DRIVEN ROTARY OIL BURNERS
- MECHANICAL PRESSURE ATOMIZING OIL BURNERS
- DUAL STAGE, Combining Steam and Mechanical Atomization
- LOW AIR PRESSURE OIL BURNERS
- AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
- GAS BURNERS
- COMBINATION GAS & OIL BURNERS
- FUEL OIL PUMPING and HEATING UNITS
- FURNACE RELIEF DOORS
- AIR INTAKE DOORS
- OBSERVATION PORTS
- SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1268 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

For more data circle 558 on Post Card

Dalles and Bonneville dams and power plants on the Columbia River. From 1916 to 1920, he was engaged in the design of hydroelectric plants for the Great Lakes Power Co. of Sault Ste. Marie, Ont.

From Mr. Harza's Chicago office have come the designs for such other significant projects as the Dix River Dam in Kentucky, the Loup River plants in Nebraska, the Santee-Cooper Dam and power house in South Carolina, the power installations at Fort Peck, Norfolk and Bluestone Dams and the Rio Negro development in Uruguay.

His firm is at present consulting and supervising engineer on the Maithon Dam of India's Damodar Valley Authority, and until last year Mr. Harza had served as head of the three-man consulting board to the authority. During this period, Mr. Harza spent one month out of every four in India. His latest accomplishment was the design of Ambuklao Dam in the Philippines, world's highest rockfill dam, now under construction.

Harza Engineering Co. will be carried on by his associates Calvin V. Davis, E. Montford Fucik and Richard D. Harza, his son.

NEW ENGINEERING BOOKS

Pipefitters Handbook, compiled by Forrest R. Lindsey, 282 pages; illustrated; size 4 by 7 in.; fabrikoid binding. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $6.00.

Quick solutions to shop or field problems in connection with pipe bending, offsetting, mitering, etc., are immediately available from the original tables of the author. Prepared as a working notebook over a period of 35 years, these tables reflect the best practical experience of a union pipefitter covering work for heating contractors, oil refiners, public utilities, industrial piping contractors and most of the large automotive plants in and around Detroit.

Planned for easy answers to everyday problems, (very useful for apprentice instruction) Mr. Lindsey's handbook is crammed with short items for the practical engineer. His first 67 pages are worked-out figures for setback and length of bend for a very wide range of angles and radii. In addition, basic formulas are given for the occasional case where the tables do not give the answer; then the user can work out the answer.

Several pages are devoted to offset bends of 22½, 30, 40, 45 and 60 deg for one or two pipes, crossover bends, V-bends; 90 deg offset bends (one or more pipes, equal spread); continuous bend offsets.

A 21-page section contains data for laying out mitered joints; construction of templates for a true wye. Another section gives dimen-

THE Amerigear* FULLY CROWNED TOOTH DESIGN

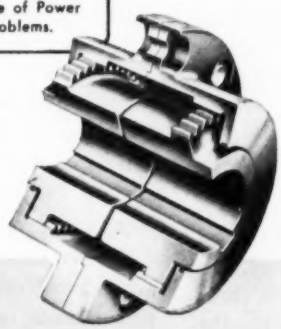
*Trade Mark Reg.

Solves Long-Standing Power Transmission Problems

Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve with a Ball and Socket Action
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

Amerigear*

Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

This fundamental improvement in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. These and other exclusive advantages of Amerigear Couplings distinguish them from common gear-type couplings. There are numerous instances where the fully crowned tooth design of Amerigear Couplings has been utilized to simplify power transmission mechanisms and add reliability to performance in a measure heretofore considered impossible.

Amerigear Couplings offer many more advantages than are obtainable with common basic designs. If your problem arises from excessive offset or angular misalignment, tight backlash requirement, space limitations, high speeds and loads, or any combination of these, it can be solved by the use of Amerigear Couplings. Amerigear Engineers are available for consultation.

Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

AMERICAN FLEXIBLE COUPLING COMPANY

ERIE, PA., U. S. A. ***Originator of the Amerigear Fully Crowned Tooth***

Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q. Canada

American Flexible Coupling Co., Erie, Pa., U. S. A.

Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

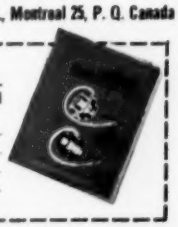
Name ..... *Title* .....

Company .....

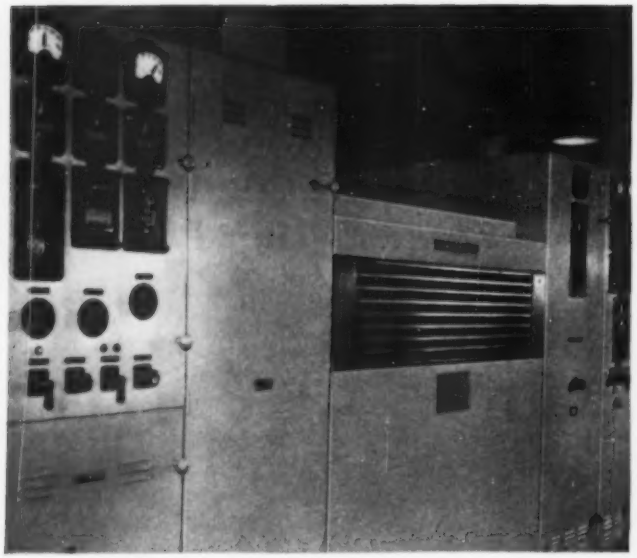
Address .....

City ..... *State* .....

Please attach to your business letterhead.



For more data circle 559 on Post Card



D-C UNIT SUBSTATION has G-E open-ventilated dry-type transformer with rectifier section. Located in power house near main foundry at Roll and Machine Works Division, U. S. Steel.

G-E MERCURY-ARC rectifier section converts the 4160-volt a-c power, purchased by the plant in Canton, Ohio, from the Ohio Power Company, to d-c power.

G-E Ignitron Power Rectifier operates 24 hours a day, 7 days a week for 3 years

AT U. S. STEEL FOUNDRY—one of the giant machine tools operated on d-c power provided by G-E rectifiers.

Roll and Machine Works Division of U. S. Steel has not changed a tube in 3 years

More efficient, safer, *reliable* conversion to d-c power with G-E mercury-arc power rectifiers—that has been the experience of this Canton, Ohio, division of United States Steel Corporation.

The foundry, which makes iron rolls for the parent company, has not had to change a tube in three years of operation. In 1950, the plant switched from 3 steam-driven reciprocating machines to rectifiers. This changeover has saved the company considerable expense, since G-E ignitron rectifiers require a minimum of maintenance as there are no major moving parts to require replacement.

For details on how G-E mercury-arc rectifiers can help with your d-c power needs, call your nearest G-E sales office. General Electric Company, Schenectady 5, New York.

883-3

You can put your confidence in—

GENERAL ELECTRIC

For more data circle 560 on Post Card

sions for various kinds of pipe, pipe threads and copper tube. The interesting table, "Expansion of Pipe per 100 Feet," is used to determine thermal expansion of pipe.

Other data, arranged according to classification, include overall dimensions and laying lengths of screwed fittings with tables showing how much clearance a pipe line must have between another pipe line or adjacent obstruction to allow for turning the screwed fittings; laying lengths for butt welding fittings, flanged fittings, valves; dimensional data on cast brass solder joint fittings; miscellaneous and mathematical data, and an eight page glossary of terms used in pipe-fitting.

* * *

The Science of Flames and Furnaces by M. W. Thring. Size 5½ by 9 in.; 416 pp, including index; illustrated; cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $6.50.

What goes on inside a furnace? Because all metals, glass, ceramics, cement, and even building brick are either melted or undergo some physical or chemical change of high temperatures, it is well to know what goes on inside a furnace. The answer to this and many other questions will be found in this book on furnaces.

The book is broken down into seven sections, covering: the function of a furnace; the thermodynamics of furnace heating; the liberation of heat by combustion; heat transfer; the aerodynamics of hot systems; the science of furnace construction; and the application of the scientific method of furnaces. It might be well to note that the book deals mainly with furnaces heated by flame and omits any discussion of electrical furnaces.

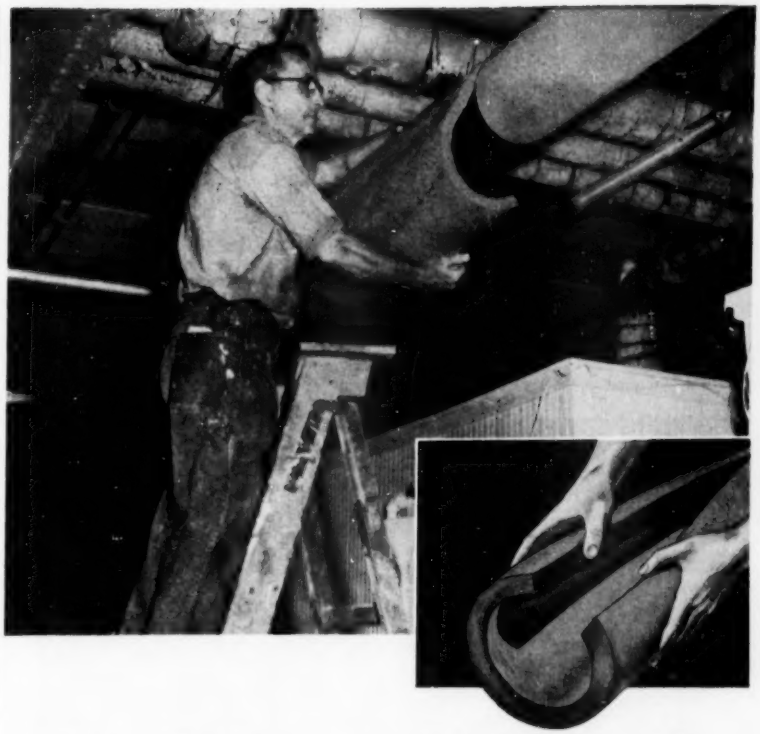
* * *

Theory and Design of Steam and Gas Turbines, by John F. Lee; 502 pages, illustrated; size 6 by 9 in., cloth binding. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. Price $9.00.

To serve as a combined text on both steam and gas turbines for the mechanical engineering student, this new text has been written. The gas turbine is included because of its increasing importance as a prime mover, also because the basic principles involved in the two types are so similar. This is the first combination treatment since Stodola used it 50 years ago in his famous book Steam and Gas Turbines, the "bible" of turbine men ever since.

Such combined treatment, the author says, is also much needed by the practicing engineer who is familiar with steam turbines and now finds it necessary to become familiar with the gas turbine.

From these two points of view we think the author has done a very good job. For POWER ENGINEERING readers, it seems to us the book will not only give them the fundamental principles on which their specific turbines operate but also shows the link be-



How Stetson saved 20% with *"that new snap-on pipe insulation"*

By using Gustin-Bacon's new "snap-on" pipe insulation of fine glass fibers, the John B. Stetson Company recently saved 20% on a pipe insulation job in its Philadelphia plant.

The major saving arose from the fact that one maintenance man did the entire installation, while other methods would have required two men. Because of the exceptionally light weight of Gustin-Bacon Ultrafine Pipe Insulation he was able to carry 6′ sections of pipe insulation up the ladder easily. Then he simply spread the section apart at the seam, slipped it over the pipe—and it snapped into place. He secured the seam with staples and binder—no wire or covering was necessary. And lastly, he painted the insulation to improve appearance.

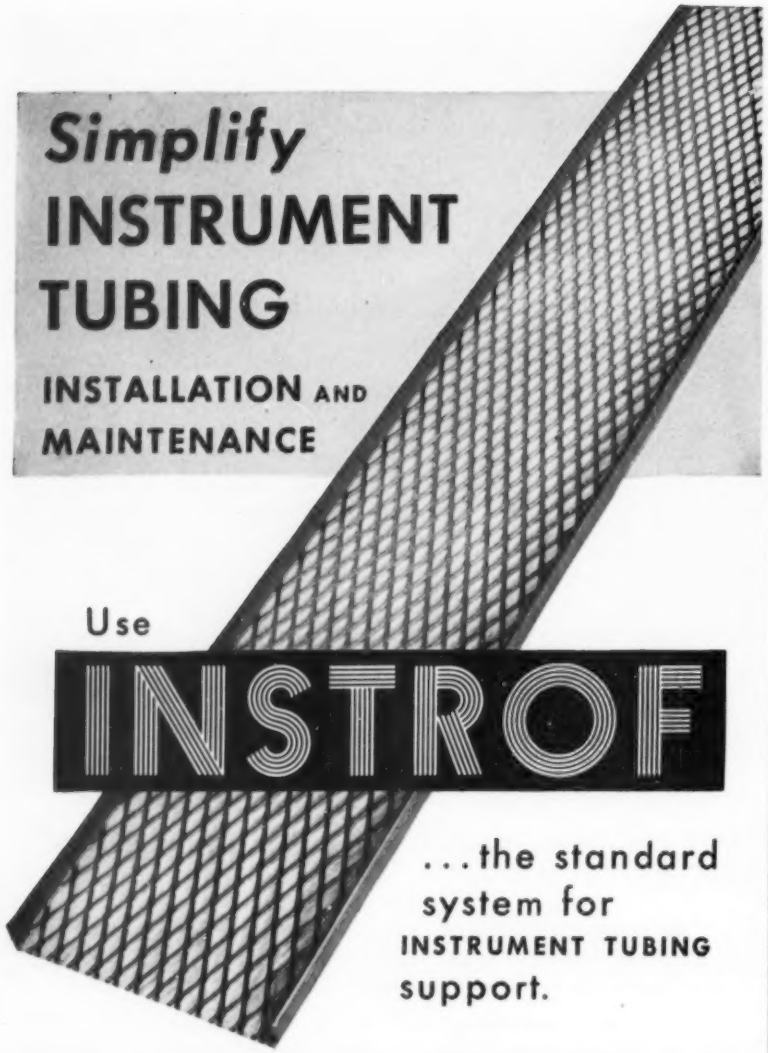
Stetson's cost-cutting experience is typical of that of other industrial leaders across the country. So if you have a pipe insulating job coming up, write today for information. We'll send you samples and complete information on the new pipe insulation that is thermally superior . . . lighter in weight . . . won't break or crumble . . . won't absorb moisture . . . can be easily cut with a knife . . . can be painted. Write *today!*

gb

GUSTIN-BACON MFG. CO.
250 W. 10th St., Kansas City, Mo.

New York • Chicago • Philadelphia • San Francisco • Los Angeles
Houston • Tulsa • Dallas • Detroit • St. Louis

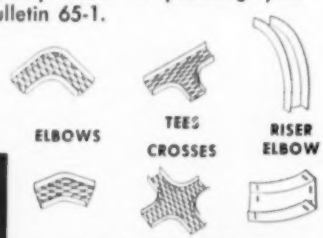
For more data circle 561 on Post Card



Now, you can simply and quickly assemble and erect a light but strong mechanical protection and continuous support for instrument tubing in new or old construction. Instrof, a proved system of prefabricated steel trough and fittings, is the modern, economical answer to this need. It is so versatile in application that with the use of standard fittings, changes in direction and elevation are made without difficulty.

Assembly requires only the use of nuts and bolts which are supplied. Complete Instrof system is hot dip galvanized for long life with minimum maintenance.

Experienced Instrof engineers will gladly assist in planning your installation. For full details write for Bulletin 65-1.



INSTROF

and other necessary fittings

INCORPORATED

4923 PENTRIDGE ST.
PHILADELPHIA 43, PA.

For more data circle 562 on Post Card

tween steam and gas turbines.

The author is associate professor of mechanical engineering at North Carolina State College and formerly taught at the University of Maine. It is especially interesting that he has dedicated his book "to William F. Ryan, friend and inspiration to young engineers." That comment fits the well-known engineering manager of Stone & Webster Engineering Corp., and if he is meant, then we think this is a most fitting and well-merited dedication.

The book begins with a chapter on Steam Turbine Types and a second on Gas Turbine Types. For the reader who needs a brief review of the thermodynamics of turbines, Chapters 3 and 6 give them.

Chapters 4 and 5 cover steam and gas turbine cycles. Design of nozzles, one of the most important factors influencing turbine performance, is treated in Chapter 7.

Just why and how the energy of the steam or gas is interchanged between the fluid and the rotor of a turbine should be understood by turbine users and these are thoroughly covered by Chapter 8.

Subsequent chapters discuss in detail the design of turbine flow passages, mechanical aspects of turbine design, steam-turbine control and performance, centrifugal and axial-flow comparisons, combustion, the regenerator and the gas-turbine power plant as a whole. Abridged steam and gas tables are included.

For the engineer who wants to delve into the details of design of turbines, this book should be very useful. He will have to know or learn some mathematics to understand everything, but even without that, the book will be very helpful to him.

* * *

Power Plant Engineering, by Frederick T. Morse, M.E., E.E. Third Edition; 677 pages; 6 x 9 in.; illustrated; cloth. D. Van Nostrand Company Inc., 250 Fourth Avenue, New York 3. 1953. Price $8.75.

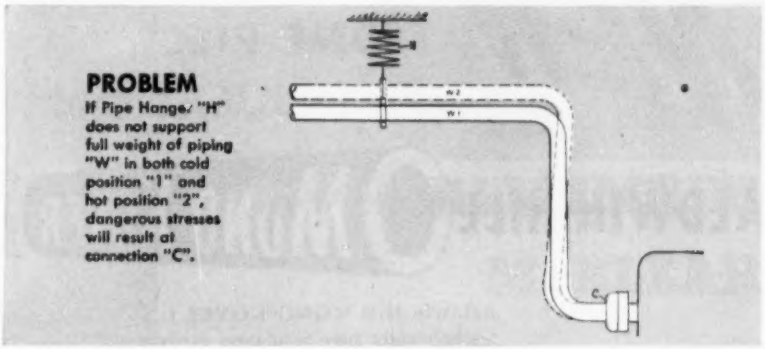
This is the third edition of Professor Morse's excellent book, originally titled Power Plant Engineering and Design, and the relationship between this new edition and the earlier ones is best explained by the author himself in the opening remarks of his preface. He says "This book is the result of work that started as an intended revision of the author's Power Plant Engineering and Design. Out of the experiences of twenty years of teaching and consultive engineering which have followed publication of the first edition have come many ideas for change — additions, deletions, and modifications. These ideas have been incorporated into the present book, and the result must be considered as more of a new book than a revision.

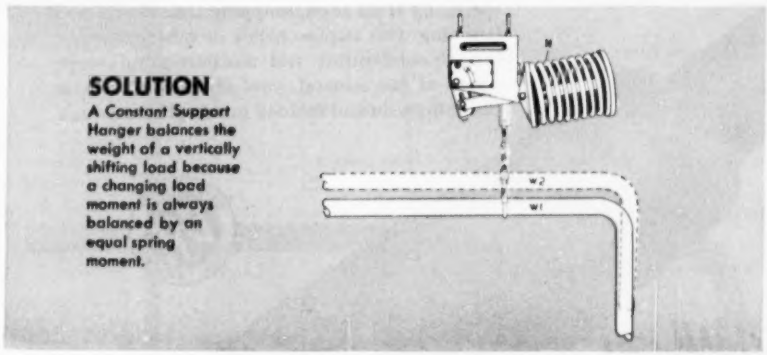
"The objective continues to be the presentation of a thorough study of stationary power and heating plants, including public service, industrial and institutional varieties."

This book maintains the high standards of its predecessors. Unlike many authors, who treat power plant equipment and opera-

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.


PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

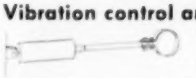
Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

GRINNELL COMPANY, INC.

280 West Exchange St., Providence, Rhode Island

Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

Name .....

Company .....

Address .....

City ..... State .....

For more data circle 516 on Post Card

NEW "SNAP-ON" ONE PIECE PIPE INSULATION

BALDWIN-HILL MONO-KOVER

Baldwin-Hill MONO-KOVER is a flexible, featherweight pipe insulation easily applied by spreading at the seam, snapping around pipe and fastening with staples, bands or other fasteners. It is incombustible and moisture-proof—composed of fine mineral wool fibers bonded with phenolic resin and molded in one piece sections.

- Extra Light Density
- Easily Cut and Fitted
- Six Foot Lengths
- Resilient, Flexible
- Won't Break or Crumble
- Easy to Paint
- Highly Efficient
- No Coarse Fibers
- Takes Rough Handling
- Effective Up To 350° F.
- Easily Nested
- Non-Corrosive
- Won't Rot, Decay, Mold
- Lower Applied Cost

Write For Complete Information

BALDWIN-HILL COMPANY

202 BREUNIG AVENUE • TRENTON 2, NEW JERSEY

Kalamazoo, Michigan . . . Huntington, Indiana . . . Temple, Texas

For more data circle 563 on Post Card

tions as isolated functions, Professor Morse treats the whole power plant as a unit whose purpose is to transform the input low grade energy of fuel into high-grade electrical energy for power plant output. Though the modern power station represents a large investment in thousands of separate items, nearly all function to transfer or transform energy, and Prof. Morse shows how these energy flows can be separated. For example, the Feedwater Loop follows the water path from condenser through the various pumps and heaters, through the boiler to steam and back to the condenser; the Combustion Loop (or Gas Loop) traces the heat path from the fuel, through combustion to the stack and to the ash disposal system. By separating these energy flows he not only makes them easier to understand, but shows how they all contribute to the common goal of the power plant.

Though some sections on hydraulic power and electrical equipment have been omitted from this edition, the steam plant has been given more coverage than in the others.

Like its predecessors, Power Plant Engineering presumes that the reader is familiar with Elementary Heat Power or Applied Thermodynamics, but more attention has been given to review and explanation of fundamentals in this volume than in the others.

A chapter has been included on the gas turbine as an indication of its potential importance in the stationary power plant field.

We recommend this book to all power engineers.

* * *

ASME Boiler and Pressure Vessel Code, Section 1; Rules for Construction of Power Boilers, 1952 Edition; 142 pages, with drawings, charts, and tables; size 11 by 8 in., paper binding. Published by The American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York 18, N. Y. 1953. Price $3.00.

This revision of Section 1 of the Boiler and Pressure Vessel Code supersedes the 1949 edition. It deals with the construction of power boilers to be used in stationary service, and covers the following aspects of boiler construction: — Selection of materials, minimum thicknesses of plates and tube sheets, tubes and pipe, rules for fusion welding, maximum allowable working pressures for steam power boilers, boiler joints, ligaments, domes, dished heads, flat heads, braced and stayed surfaces, tube sheets of combustion chambers, headers, deformation tests, cutting of plates, tubes, riveting, calking, access and inspection openings, nozzle openings, safety valves, water and steam gages, fittings and appliances, setting, hydrostatic tests and stamping.

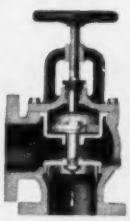
Then follows an appendix, which is "Explanatory of the Code and containing matter which is not mandatory unless specifically referred to in the rules of the Code." This appendix has sections on the efficiency of joints, braced and stayed surfaces, methods of checking safety valve capacity by measur-

You can forget control problems if you REMEMBER McALEAR

There's a safe way to forget all about your control problems—just remember McALEAR. For when you use McALEAR controls you benefit from a background of fifty years of experience covering every type of installation. You know you have controls engineered to an exactness . . . controls that are just right for the specific job. You can depend on McALEAR because (1) There is an expert engineering service behind every product; (2) McALEAR sales representatives are hand picked for control know-how; (3) McALEAR controls are available through leading plumbing and heating wholesalers.

6 OF THE MANY McALEAR CONTROL GUARDSMEN

Pilot-operated pressure reducing valve for accurate control of reduced pressures . . . single seated closed valve affording dead end service.

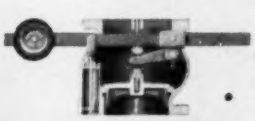


Stop and check control—used with two or more boilers—automatic safeguard against reverse steam flow.

Suction and pressure type strainer—clamped or bolted cover—adaptable to any strainer service.

Self-cleaning "Y" strainer — used to protect regulators, pumps and traps by removing foreign matter from the line.

Feed water regulator—used for continuous feed to boiler to maintain water level. Has mercury cut-out switch as additional safeguard in case of low water.



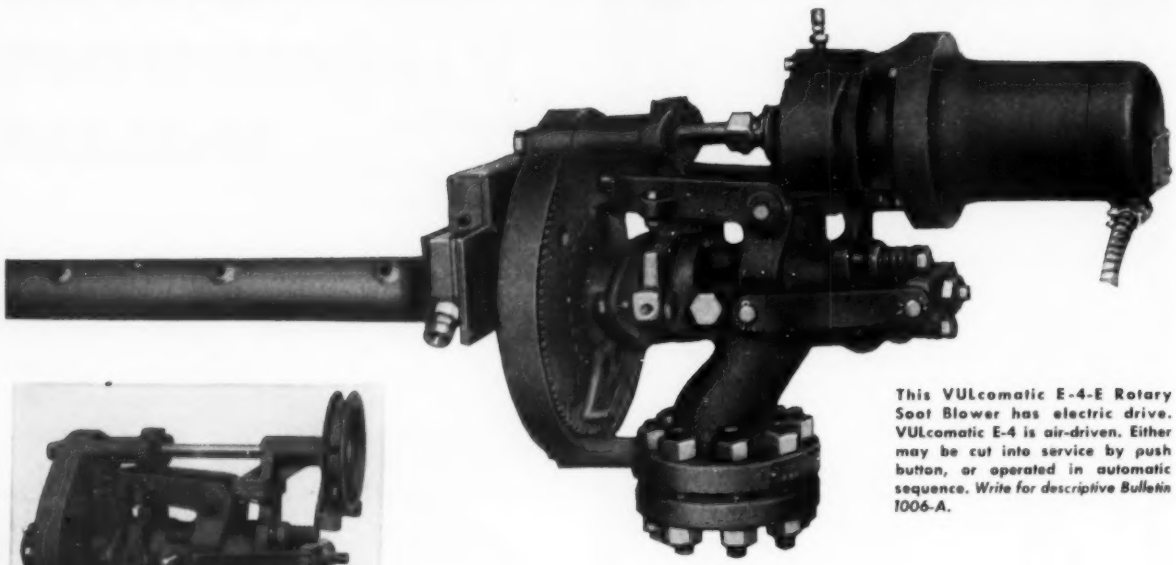
Back pressure valve—Single seated vertical type . . . efficient—noiseless. Operates with condensing and non-condensing engines.

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL-GAS

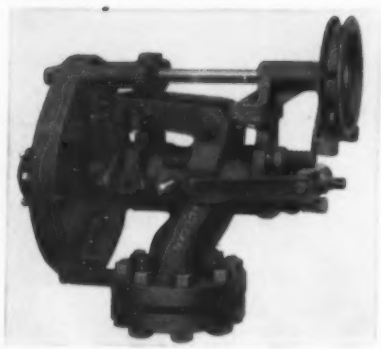
McAlear Manufacturing Company
1901-1919 South Western Avenue
Chicago 8, Ill., U.S.A.

For more data circle 564 on Post Card

Here's the answer to SOOT *and* DUST REMOVAL



This VULcomatic E-4-E Rotary Soot Blower has electric drive. VULcomatic E-4 is air-driven. Either may be cut into service by push button, or operated in automatic sequence. *Write for descriptive Bulletin 1006-A.*



Manually-operated Vulcan P-3 is identical with VULcomatic E-4-E or E-4, except for drive. May be quickly converted to an automatic unit by replacing sheave wheel with air or electric motor. *Bulletin 1005-A.*

MOTOR DRIVE or MANUAL

With Vulcan Rotary Soot Blowers, you get full cleaning pressure—from the crack of the valve to the end of the cycle. Exclusive trigger-action valve assures uniform speed of rotation for better cleaning, and closes automatically. While closed, it seals off corrosive furnace gases to protect internal parts. You can install Vulcan Rotaries at any angle. You can inspect or repair any part—with an ease that saves maintenance time and money.

COPES-VULCAN DIVISION
Continental Foundry & Machine Company
ERIE 4, PA.

VULCAN Rotary SOOT BLOWERS

For more data circle 565 on Post Card

ing maximum amount of fuel that can be burned, various tables giving sizes of steel pipe flanges and flanged fittings for different pressure ratings, automatic water gages, fusible plugs, and standard practice for making hydrostatic tests on a boiler-pressure part.

At the end of the book are suggested rules covering existing installations, which apply only to boilers which do not carry the Code symbol. This section deals with maximum allowable working pressures, strength of materials, safety valves for power boilers, fittings and appliances, examples of methods of computing openings in shells, examples of computing allowable loading on structural attachments to tubes, approval of new materials under the ASME Boiler and Pressure Vessel Code, maximum working pressures for thick shells, steel castings inspection and marking requirements. This section concludes with specimen forms for manufacturers' test report for safety valves, manufacturers' data report, certificate of boiler shop inspection, and certificate of field assembly inspection for boilers, superheaters, waterwalls economizers and fabricated piping; inspection reports and a certificate of authorization.

* * *

ASME Boiler and Pressure Vessel Code Section VIII; Rules for Construction of Unfired Pressure Vessels; 1952 Edition; 183 pages, with drawings, charts and tables; size 11 by 8 in., paper binding. Published by The American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York 18, N. Y. 1953. Price $3.00.

This revision of Section VIII of the Boiler and Pressure Vessel Code supersedes the 1949 edition. It starts with the general requirements for all methods of construction and all materials for unfired pressure vessels, followed by the requirements for unfired pressure vessels fabricated by welding, by riveting, by integral forging, by brazing; vessels constructed of carbon and low alloy steels, of nonferrous materials, of high-alloy steel, of cast iron, and of integrally clad plate or with applied corrosion-resistant linings.

Mandatory appendices include supplementary design formulas, rules for bolted flange connections, and definitions. Nonmandatory appendices include porosity charts, approval of new materials under the ASME Boiler and Pressure Vessel Code; suggested methods for obtaining the operating temperature of vessel walls in service, suggested good practice regarding internal structures, suggested good practice regarding corrosion allowance, suggested good practice regarding linings, suggested good practice regarding design of supports, capacity conversions for safety valves, sectioning of welded joints, examples illustrating the application of code formulas and rules, installation and operation, steel castings inspection for higher quality factor, various tables giving dimensions of steel pipe flanges and flanged fittings for different pipe sizes and pressure ratings, a basis for establishing

Choose WESTERN
for Chemical Treatment of Water, Steam and Fuel

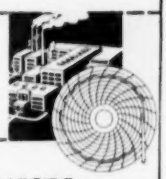
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

1 Steam + CORAVOL = Protection (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.



3 COOLING WATER TREATMENT AND ALGAECIDE

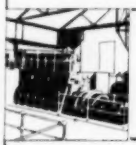
Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.



6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

717 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY
Western Chemical Company
717 Washington Street
Kansas City 5, Missouri

Send me full information about products checked.

1 2 3 4 5 6 7 8 9

Name

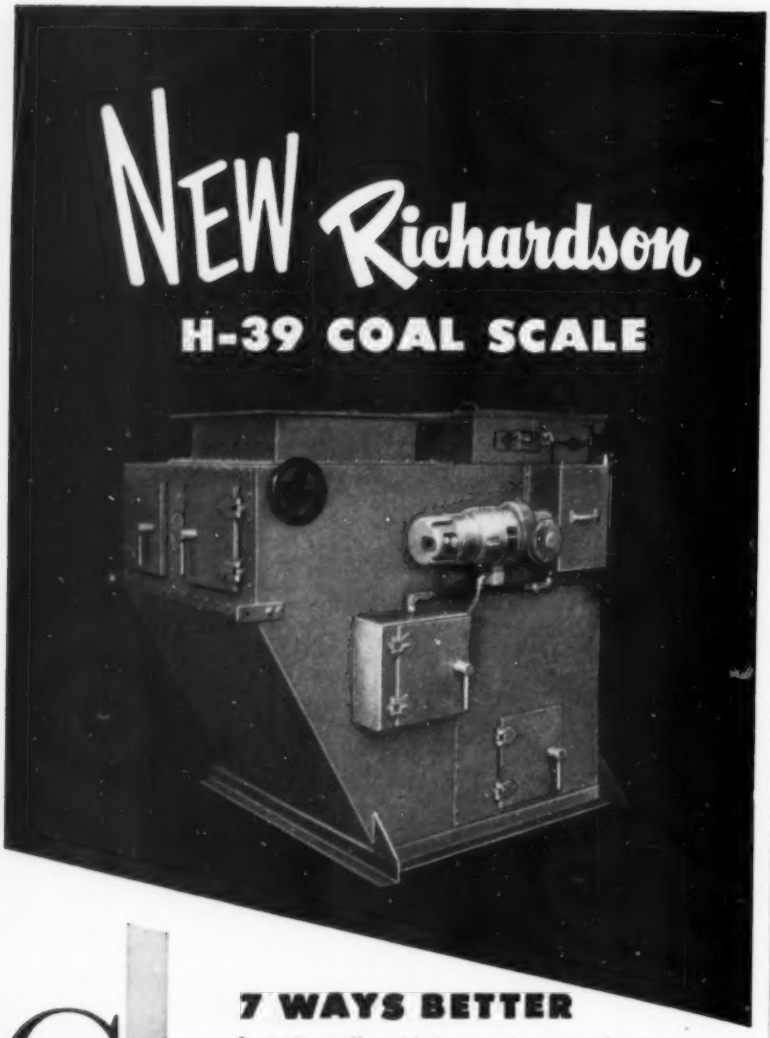
Firm

Address

City Zone State

For more data circle 566 on Post Card

NEW Richardson
H-39 COAL SCALE



Compare...

7 WAYS BETTER

1. 24" x 24" coal inlet opening—50% greater area—for maximum flow-ability of coal.
2. *All* wiring and controls outside coal chamber.
3. Beam-ratio test facilities *completely outside* coal chamber.
4. Simple, gravity-operated bypass arrangement with no restriction in coal flow to downspout.
5. No drag-links or electrical wiring on weight hopper.
6. Construction of access doors makes it *impossible* for coal dust to spill out on floor when opening.
7. Unequalled nationwide maintenance and service facilities.

That's why you just can't *buy better than a Richardson*

Get all the facts. Write for Bulletin 0352 today!

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Detroit • Houston
Minneapolis • New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita • Montreal • Toronto

Richardson

8616 MATERIALS HANDLING BY WEIGHT SINCE 1902

For more data circle 567 on Post Card

stress values for ferrous and non-ferrous materials, and the recommended practice for inspection, repair, and allowable working pressures for vessels in service.

The book concludes with specimen forms for manufacturers' data report for unfired pressure vessels, certificate of shop inspection and certificate of field assembly inspection, manufacturers' partial data report, manufacturers' certificate of compliance covering unfired pressure vessels to be stamped with the UM-symbol, manufacturers' test report of safety valves, and a certificate of authorization.

* * *

Lead Work for Modern Plumbing. Size 7¾ by 5 in.; 164 pp; illustrated; plastic-ring bound. Published by Lead Industries Assoc., 420 Lexington Ave., New York 17, N. Y. Price $1.50.

Lead is one of the oldest plumbing materials in existence and still going strong. The Romans used it for water pipes and there were other users even before them. Today it is probably used more than ever, with added refinements.

This handy book covers many facets of lead work that should be of interest not only to the craftsman but to others concerned with the use of lead. The text is clear and concise, covering tools, procedures and methods. The following are some of the main sections in the book: lead working tools; soldering with irons; wiping joints; making sheet lead pans and linings; installation details; and lead welding.

* * *

Research Operations in Industry, edited by David Hertz. Size 8½ by 5½ in.; 453 pp; cloth binding. Published 1953 by King's Crown Press, Columbia University Press, 2960 Broadway, New York 27, N. Y. Price $8.50.

This telescopic view of the industrial engineering field is reprinted directly from papers and discussions of the Third Conference on Industrial Research, June 1952, Columbia University. Papers from the first and second conferences emphasizing the importance of economics, costs and budgeting are also included.

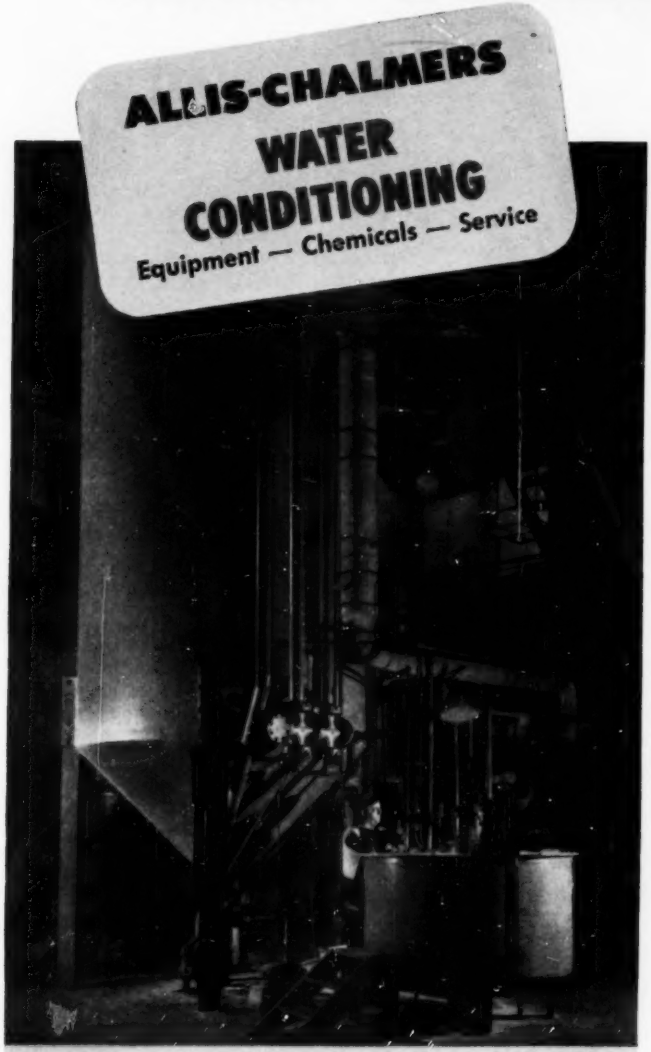
An interesting picture of modern research operations as presented by leaders in industry, government and universities, is easily focused with this single-volume compilation.

The book contains many principles in an allied field of engineering that can be of practical value to the power engineer. These may pertain to the policies of decentralizing authority and responsibility for more effective efficiency, the importance of selling a research project to top management, or the know-how for culling ideas from every individual straight down the line. There are also factual data, such as gained from the Olin industries' plan, which may inspire a particular method of evaluating the results of on-the-job research.

Government's cumbersome handling of budget preparations is treated as an excellent example of what not to do. It is paralleled, of course, by specific methods used in pri-

Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4190

ALLIS-CHALMERS

For more data circle 568 on Post Card

HEAT UP
STEAM UNITS
IN 1/8 THE TIME
WITH
Heat-Kwik
Super-Silvertop Steam Traps
Interested in getting more production out of your steam-consuming units? Then equip them with the new Heat-Kwik Super-Silvertop Steam Traps. One of the most important steam trap developments in our times, Heat-Kwiks heat up units in 1/8th the time of ordinary inverted bucket traps . . . three times as fast as so-called air eliminator or blast type traps. Everywhere users are adopting these phenomenal traps as the answer to fast heating up, more production, and lower steam consumption. You, too, can save money by standardizing on Heat-Kwiks. See your Super-Silvertop distributor or mail coupon for further information.
SUPER-SILVERTOPS...
Quality Steam Traps Since 1886
The V. D. ANDERSON Company
1977 West 96th Street • Cleveland 2, Ohio
Please send me a copy of your Bulletin 1153 describing Heat-Kwik Steam Traps.
Name Title
Address
City State
ANDERSON
For more data circle 569 on Post Card

vate industry which have resulted from the necessity of cutting costs. All of this can be of value to the power engineer and within the realm of his own operations.

If he is curious about other fields, he may see the many hurdles facing the transition of improved or new products to production, pilot-plant operations, field tests, and the semi-works stage. At some future time the power engineer may need the definition of a "work use space module" and the operating theory of distributing "module points" for pipe and wire services in the design of a laboratory building. In the planning of Government's large medical research center at Bethesda, Md., for example, which is the subject of a special paper, "six years elapsed between the start of active planning and the beginning of the Clinical Center Operations." The four phases of its planning which evolved into financial, functional, special-area, and occupancy planning, were partially motivated by "some fifty-five outside experts who took time as private citizens to give their best judgment on some phase of the functioning or structure of the National Institutes of Health."

The compilation of *Research Operations in Industry* covers a series of subjects under these eight divisions: Philosophy and Management's Appraisal of Research; Economics, Costs, and Budgeting; Personnel in Industrial Research; Planning of Research Programs; Planning of Research Facilities; Research Methodology and Design of Experiment; Operations Research; Communications and Technical Information Services.

* * *

Timing Engineering, by Myrten G. Saake; 243 pages, illustrated; size 5 x 9 in., cloth binding. Published by Ribble Engineering Co., 74-80 Montgomery Street, Jersey City 2, N. J.; 1953. Price $5.00.

Here is an excellent and timely book covering both theory and application of timing and counting devices. With the increasing trend toward automation, such a volume has a definite place on the engineer's book shelf.

Well illustrated, the book answers questions on the subject which often are thought too basic to deserve attention. This broadens its usefulness to all engineers, even making it useful to engineers who do not know all about the subject before they buy the book. The author apparently takes the refreshing view that the reader need not study that part of the book which he already understands unless he wants to, and includes the material for those who need it.

Although the book is written in such a manner that it could serve as a textbook for instrument trainees or college students, it is well indexed and will probably find its greatest use as a reference.

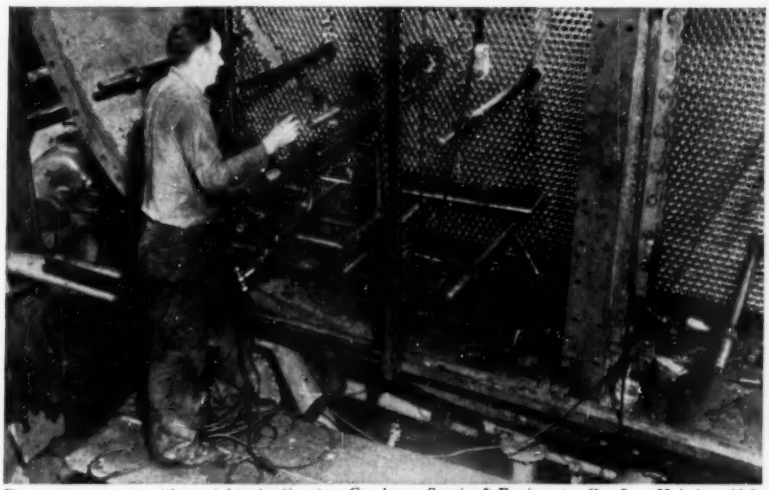
Wiring diagrams, specific installations cited, detailed descriptions of equipment items, methods of constructing time-cycle charts for setting timer controls and discussions of related equipment make this book complete in its field.

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Retubing condenser with special tools—Courtesy Condenser Service & Engineering Co., Inc., Hoboken, N.J.

Performance Surveys Increase Condenser Tube Life

Keeping careful and complete records of tube performance in each unit is good practice. The information obtained is valuable in many ways:

1. To determine the life cycle of a particular tube alloy so that retubing can be anticipated and shut-down time minimized.

2. To reveal the changes in the character of the circulating water and its effect on tube life.

3. To study changes in operating conditions with the objective of lengthening tube life.

4. To compare the behavior of different tube alloys under operating conditions as an aid to retubing with a longer-lasting alloy.

Improved Results Through Records

Many examples show surveys have led to lengthened tube life, improved heat transfer and greater tube efficiency. A plant operating its surface condensers on an intermittent basis for many years received satisfactory service from Admiralty. When it changed to a continuous basis and with a somewhat higher water velocity, Admiralty failed in two years as compared with six to twelve years previously. This plant changed to Aluminum Brass and now gets tube life comparable to Admiralty under intermittent service conditions.

In an oil refinery it was found that the product was considerably more corrosive toward copper-base alloys than toward steel due to the presence of large amounts of ammonia. However, the steel corroded rapidly on the water side. By changing to Duplex tube, consisting of steel to the product side and Red Brass to the water side, tube life was increased from four to five times.

Information Helps Find Key to Corrosion Attack

Corrosion, the greatest enemy of tube life, is most difficult to pin down since it is influenced by many variable conditions. Here information about operating procedures, composition of the water, steam, gas, product, temperatures, velocities, etc., plays a vital role in tracking down and correcting conditions that lead to corrosion and in finding the right alloy to withstand corrosive attacks.

Information on tube performance is especially valuable where failures are localized in some section of a condenser or heat exchanger, such as at the inlet end of the tubes, because a change in operating conditions or a better tube alloy is indicated. For example, excessive inlet end corrosion of Admiralty tubes can be reduced by changing to Aluminum Brass or Duronze IV (Aluminum Bronze). Where general corrosion (thinning) occurs along the entire length of the tubes, a change to a more corrosion-resistant alloy such as Aluminum Brass, Duronze IV, or Cupro Nickel may be indicated. The selection of the most suitable alloy can be determined from tests on sample tubes of different alloys.

Our Corrosion Laboratory is available for advising which alloy will give the longest service life for specific operating conditions.

Information concerning the performance of the tubing from data sheets should be sent along with the tube sample or samples. The tube alloy, character of circulating water and its temperature range, velocity, product handled, length of service, etc., are, of course, necessary in helping to diagnose tube failure.

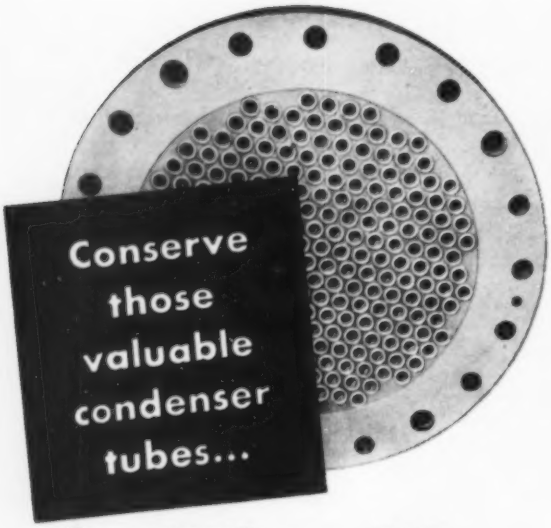
Proper Sampling

When submitting samples for Laboratory examination, it is important that a full length tube be submitted because a short piece may not be representative, since corrosion attack is generally not uniform throughout the tube. Consequently, the inlet end of the tube should be identified as well as the position of the tube and its location in the condenser or heat exchanger. A scratch line should be drawn on the outside of the tube along the top. When the tube is cut into shorter lengths for mailing, the pieces should be numbered progressively from the inlet end. We have listed specifically the information needed on pages 109 to 111 (Questionnaire on Tubes) of the Bridgeport Brass "Condenser and Heat Exchanger Tube Handbook."

Technical Service Available

When considering retubing or when you have a tube corrosion problem, contact our nearest Sales Office. Write for your copy of the Bridgeport "Condenser and Heat Exchanger Tube Handbook" on Company stationery. (1173)

For more data circle 570 on Post Card



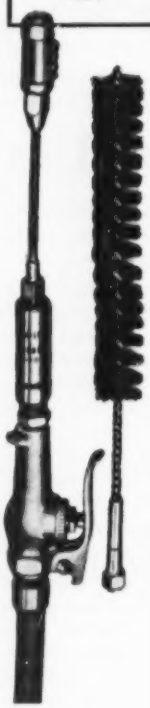
the Wilson Way

Usually a surface condenser tube fails in the first few inches of its length due to inlet end erosion. To protect against this costly deterioration, it is good practice to paint the tube sheets as well as the tube ends with a protective coating. This low-cost cleaning and application kit is designed to do the job quickly and efficiently. Only three simple steps are needed: (1) Clean all the tube ends. (2) Thin coating and squirt it into tube. (3) Attach the paint brush to the air motor and use it for fast, easy spreading.

This Wilson method insures complete removal of dirt, provides excellent paint adherence, makes certain paint is spread evenly on the tube. The work can be done in a hurry . . . with any labor available.

The Wilson Cleaning and Application Kit is but one of many Wilson accessories designed for the proper maintenance of condensers and heat exchangers. For packed condensers, there are packing tools, packing removal counterbores and ferrule wrenches. Wilson also makes a wide range line of tube cutters, tube expanders, flaring and belling tools, tube pullers, etc. TW 822

WILSON CLEANING AND APPLICATION KIT



Representatives in all principal cities

THOMAS C. WILSON, INC.

21-11 44th AVE., LONG ISLAND CITY 1, N. Y.

Cable address: "Tubeclean," New York

WILSON

TUBE CLEANERS • TUBE EXPANDERS

For more data circle 571 on Post Card

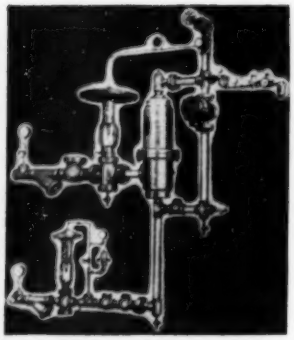
INSIST ON

Pick

INSTANTANEOUS HOT WATER HEATERS

In Daily Use in These Plants

United States Steel Co.
Ford Motor Co.
H. J. Heinz
Bethlehem Steel Corp.
Hercules Powder
General Aniline Works
and many others.



SAVES MONEY FOR ANY INDUSTRY THAT USES HOT WATER

Industries all over the country are replacing outmoded water heaters with Pick Instantaneous Water Heaters. Here are the reasons:

Water Is Heated Instantly. Entirely automatic, Pick Heaters operate by steam injection to heat the water in a flash to exact temperature desired and in volume required.

Fuel Savings Are Substantial. Steam injection heating is the most efficient method known. There's no waste because water is heated only as used . . . never stored and allowed to cool.

No Storage Tanks Required. Compact design of Pick Heaters permits out-of-the-way installation in corners, on walls or overhead. Saves valuable floor space.

Exact Temperature Control — Pick Heaters can be operated at low or high loads with minimum temperature fluctuation. And it's done quietly.

Maintenance Cost Is Low. Pick Heaters can be cleaned in a matter of minutes — worn parts easily replaced.

Installation Is Inexpensive. Only ordinary pipe connections are required.

Write Dept. PO-154

Write for booklet on how Pick Heaters cut costs of hot water. No Obligation.

PICK MANUFACTURING CO.

WEST BEND, WISCONSIN

For more data circle 572 on Post Card

Continuous records of the oxygen dissolved in boiling feed water and of the hydrogen entrained in steam, point to the corrective measures necessary to prevent otherwise unsuspected and costly corrosion. The Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measure of the oxygen set free by dissociation. Cambridge Instruments are available for recording O_2 and H_2 either separately or simultaneously.

Send for Bulletin 148-BP

CAMBRIDGE INSTRUMENT CO., INC.

3767 Grand Central Terminal, New York 17

PIONEER MANUFACTURERS OF PRECISION INSTRUMENTS

For more data circle 573 on Post Card

CATALOG LIBRARY

Standard catalogs listed monthly to help you maintain a reference library

ELECTRICAL

201 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

202 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-2, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

203 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

204 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

205 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

206 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring

FEBRUARY, 1954
Card void in 6 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Equipment	Helpful Bulletins													Catalog Library												Advertised Products and Service											
1 2 3	101	102	103	104	105	106								201	202	203	204	205	206	207	208	209	210	211	212												
4 5 6	107	108	109	110	111	112								213	214	215	216	217	218	219	220	221	222	223	224												
7 8 9	113	114	115	116	117	118								225	226	227	228	229	230	231	232	233	234	235	236												
10 11 12	119	120	121	122	123	124								237	238	239	240	241	242	243	244	245	246	247	248												
13 14 15	125	126	127	128	129	130								249	250	251	252	253	254	255	256	257	258	259	260												
16 17 18	131	132	133	134	135	136								261	262	263	264	265	266	267	268	269	270	271	272												
19 20 21	137	138	139	140	141	142								273	274	275	276	277	278	279	280	281	282	283	284												
22 23 24	143	144	145	146	147	148								285	286	287	288	289	290	291	292	293	294	295	296												
25 26 27	149	150	151	152	153	154								297	298	299	300	301	302	303	304	305	306	307	308												
28 29 30	155	156	157	158	159	160																														
31 32 33	161	162	163	164	165	166																														
301 302 303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321																		
322 323 324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342																		
343 344 345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363																		
344 345 346	347	348	349	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384																		
385 386 387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405																		

Name ..... Title .....

Company Name .....

Company Address .....

City ..... State .....
(If you prefer delivery at home, give home address, too)

Home Address .....

City ..... State .....

Use this space to ask for free charts and other information. .....

.....

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

110 South Dearborn

CHICAGO 3, ILLINOIS

FIRST CLASS
PERMIT No. 353
Sec. 34.9, P.L.&R.
CHICAGO, ILL.

system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

INSTRUMENTS AND CONTROLS

207 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

208 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

it's easy to get these free catalogs—just circle item numbers of those wanted on the post card at left.

209 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

210 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

211 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

212 Steam Calorimeter — Bulletin 118 discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of unit. Ellison Draft Gage Co., Inc.

213 How to Select Regulators — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific

FEBRUARY, 1954
Card void after 6 months

POWER ENGINEERING

Please have the manufacturers listed send me without obligation information or bulletins indicated by the numbers circled below.

Name ..... Title .....
Company Name .....
Company Address .....
City ..... State .....
(If you prefer delivery at home, give home address, too)
Home Address .....
City ..... State .....

Use this space to ask for more sheets and other information.

Equipment	Helpful Bulletins										Catalog Library										Advertised Products and Services									
1 2 3	101	102	103	104	105	106	107	108	109	110	201	202	203	204	205	206	207	208	209	210	501	502	503	504	505	506	507	508	509	510
4 5 6	107	108	109	110	111	112	113	114	115	116	211	212	213	214	215	216	217	218	219	220	511	512	513	514	515	516	517	518	519	520
7 8 9	113	114	115	116	117	118	119	120	121	122	221	222	223	224	225	226	227	228	229	230	521	522	523	524	525	526	527	528	529	530
10 11 12	119	120	121	122	123	124	125	126	127	128	231	232	233	234	235	236	237	238	239	240	531	532	533	534	535	536	537	538	539	540
13 14 15	125	126	127	128	129	130	131	132	133	134	241	242	243	244	245	246	247	248	249	250	541	542	543	544	545	546	547	548	549	550
16 17 18	131	132	133	134	135	136	137	138	139	140	251	252	253	254	255	256	257	258	259	260	551	552	553	554	555	556	557	558	559	560
19 20 21	137	138	139	140	141	142	143	144	145	146	261	262	263	264	265	266	267	268	269	270	561	562	563	564	565	566	567	568	569	570
22 23 24	143	144	145	146	147	148	149	150	151	152	271	272	273	274	275	276	277	278	279	280	571	572	573	574	575	576	577	578	579	580
25 26 27	149	150	151	152	153	154	155	156	157	158	281	282	283	284	285	286	287	288	289	290	581	582	583	584	585	586	587	588	589	590
28 29 30	155	156	157	158	159	160	161	162	163	164	291	292	293	294	295	296	297	298	299	300	591	592	593	594	595	596	597	598	599	600
31 32 33	161	162	163	164	165	166	167	168	169	170	301	302	303	304	305	306	307	308	309	310	601	602	603	604	605	606	607	608	609	610

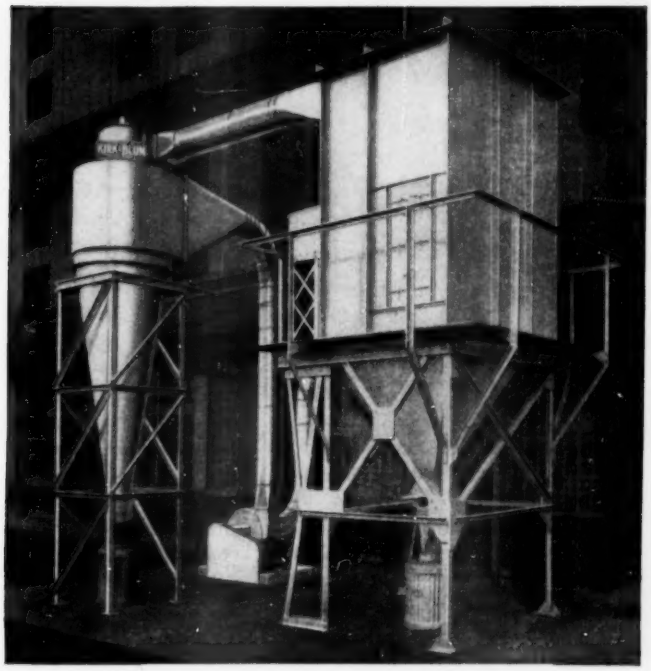
BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

FIRST CLASS
PERMIT No. 352
Sec. 34.9 P.L.&R.
CHICAGO, ILL.

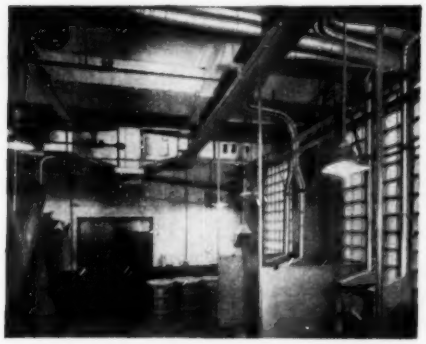
Two-stage air cleaning: high efficiency centrifugal collector (at left) plus cloth media filter.



pharmaceutical manufacturer finds

KIRK AND BLUM DUST CONTROL

"just what the doctor ordered!"



To maintain rigidly controlled and conditioned plant atmosphere, air returned from cleaning operation is heated or cooled as required.

To insure, in all manufacturing steps, the purity of The Wm. S. Merrell Company's products, Kirk & Blum Dust Control Systems were installed by this well known pharmaceutical manufacturer. Dust is eliminated at its source to meet the plant's strict requirements. Since the building is air conditioned, cleaned air is tempered (warmed or cooled) before it is returned to the plant.

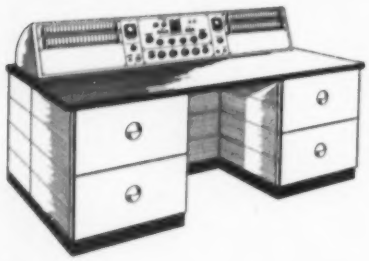
Whatever your problem, put it up to experts in air handling . . . KIRK & BLUM—with over 46 years' experience in Dust and Fume control.

KIRK AND BLUM
DUST CONTROL

FOR ILLUSTRATED LITERATURE . . . WRITE TO
THE KIRK and BLUM MANUFACTURING CO.
3230 FORRER STREET, CINCINNATI 9, OHIO

For more data circle 574 on Post Card

RCA's
new idea in Sound



—Unitized Design
—Increases System's Flexibility

Now, here's sensible design in sound systems—RCA's new "modular-design" sound equipment, offering *complete flexibility, easy expansion, at any time.*

Here's how the new RCA design techniques make an RCA Sound system the most adaptable system you can buy.

New "Modular-Design" Control Units—RCA's famous Rainbow line of small, color-coded circuit assemblies—provides unusual flexibility in the system you install now—permits practically unlimited expansion at any time in the future. These compact units—pre-amplifier, power amplifier, cathode follower, and tone control—let your RCA Sound Distributor supply your sound system exactly as you specify it. They permit the addition of new microphone locations, changes in microphone location at any time.

Unit-Built Consolettes—designed to accept RCA Rainbow line units in any combination—help keep your initial costs down—maintain the professional appearance of your system through the years in spite of changes and additions. In a single unit, your RCA Sound Consolette combines all the important benefits of RCA's modular-design construction, plus complete, built-to-order flexibility.

Check with your local RCA Sound Distributor for information or Write for the new RCA SOUND PRODUCTS CATALOG NOW. Radio Corporation of America, Sound Products, Dept. B209, Camden, N. J.

For more data circle 575 on Post Card

job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

214 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

215 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

216 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

217 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

218 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

FUEL OILS, LUBRICANTS

219 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

220 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

221 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available,

CHIEF ENGINEER WILLIAM NOTE inspects the original Leslie Temperature Pilot taken from heater for its first overhaul. Leslie Representatives Frank Riggio (*left*) and Bob Gentner (*right*) look on.

DEWITT O. HESSLER, Laundry's President, joins Chief Note in examination of the original Leslie Pilot before reinstallation.

HOW SHOULD A 21-YEAR-OLD BEHAVE?

Temperature Pilot leads flawless life for 21 years prior to its recent, initial overhaul

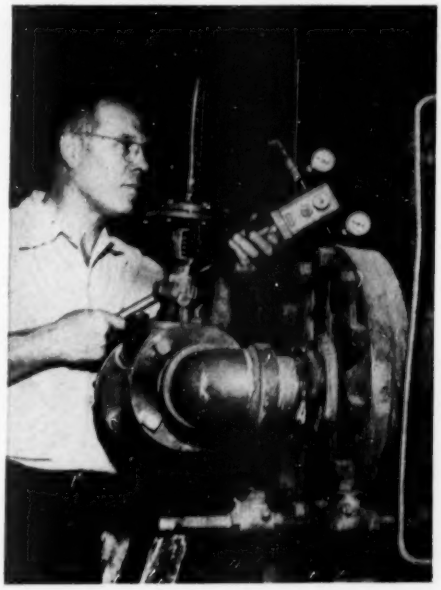
A 21-year-old Leslie Temperature Control Pilot had its "coming-out-party" recently at the Hessler Laundry, Paterson, N. J. The very first one of its kind ever made, it was installed at the Hessler plant back in 1933 by the firm's chief engineer, Bill Note—who also ordered the pilot's first overhaul in 21 years of continuous service.

The pilot was designed to control constant process temperature over extended periods without necessity for recalibration or replacement of thermal elements. The Hessler field test worked out so well that the pilot was left untouched after its initial setting, for 21 years.

Periodic inspections showed the pilot was doing the job without appreciable wear or need for *any* attention. This year, it was removed from the heater for a complete examination and after a quick clean-up, it was put right back into service.

Top performance suggests other applications

The outstanding behavior of this first pilot is being repeated today by Leslie Pilots in hundreds of other applications in all industries. The wide adjustable ranges (32°-400°F and 300°-600°F) make the pilots adaptable to most operating conditions. The fast-responding bi-metallic element responds to changes as small as ¼°F.



CHIEF NOTE REINSTALLS PILOT after *no-cost* overhaul. Parts showed no appreciable wear or corrosion after 21 years of continuous hot water heater service.

Send for Technical Data Sheet 464-14 describing Leslie Temperature Pilots and Controllers.

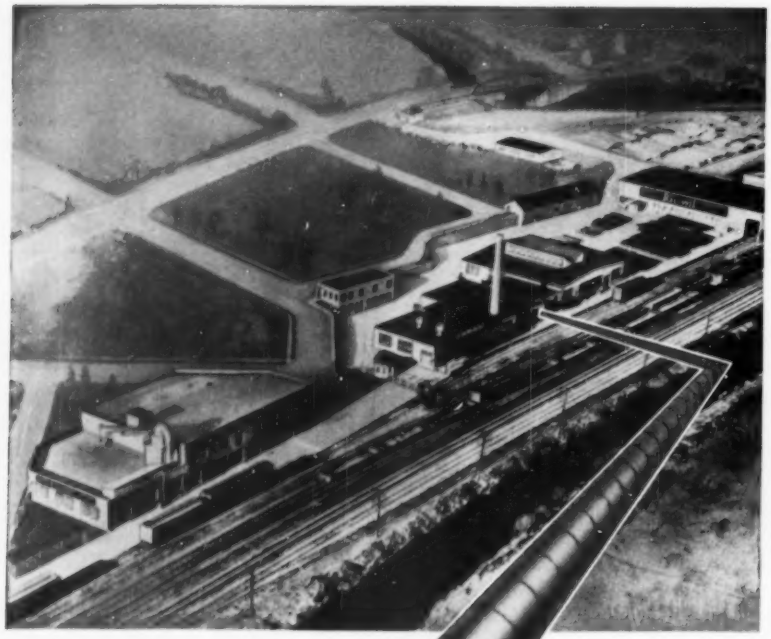
TRADE LESLIE MARK

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

LESLIE CO. 301 Grant Avenue, Lyndhurst, New Jersey

For more data circle 576 on Post Card



NEVER ENDING LINE OF

Quality

The Ric-wil Company represents over 40 years of manufacturing Quality Insulated piping systems. The complete Ric-wil product line is continuously pre-proven by laboratory and field tests to maintain this superior quality.

Contact your local Ric-wil representative or write direct for Catalog No. 5401.

Send for Catalog 5401

Quality Piping Systems of the . . .
. . . Highest Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY
BARBERTON, OHIO

For more data circle 577 on Post Card

their uses and physical properties. Standard Oil Co. (Ind.)

222 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

223 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

Postage-free cards for ordering catalogs are on pages 129-130. You may also use the cards to ask for further information on the advertised products

225 Lubrication of Chain Drives — Vol. 39, No. 8 of Lubrication offers a 10-pp discussion on chain drives and their lubrication. Covers types of chains, conditions affecting their lubrication, choice of lubricants. Includes table showing lubricant recommendations for chain drives. Generously illustrated with photos and sketches showing chain arrangements, methods of lubrication. The Texas Co.

226 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

COAL, ASH HANDLING

227 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

229 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

230 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

231 Shredder Ring Crusher — A crusher for coal and similar materials

DARLING VALVES

INSIDE STORY...

on trouble-free valve performance

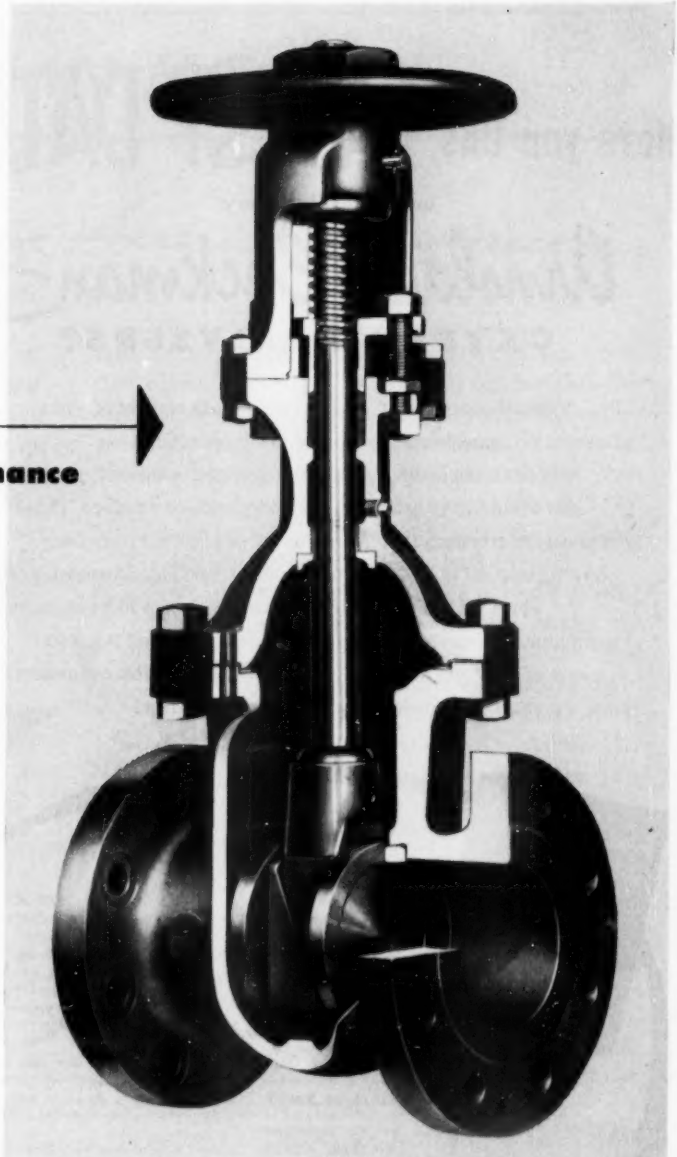
Install DARLING Revolving Disc GATE VALVES

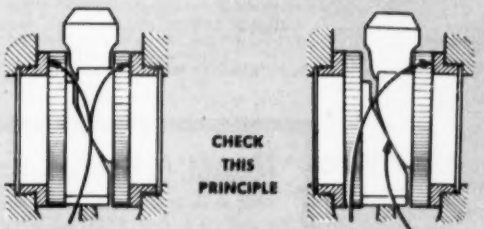
Just what the doctor ordered . . . that's what users say about Darling fully revolving double disc, parallel seat gate valves. *Reason:* These unique valves adjust automatically to compensate for valve body distortion.

Moreover, Darling gate discs, independently hung from the upper wedge and free to revolve completely, change their seating position at each closing. This means uniform wear distribution. Valves work better and last longer, require less attention, less maintenance.

Wide Range Of Sizes And Types

If you're not already a Darling revolving disc gate valve user, let us prescribe the valve you need to cure *your* valve trouble. Darling gate valves come in a wide range of types and sizes . . . and for pressures up to 1500 pounds. Simply outline your particular service needs or ask for a complete descriptive bulletin.





Above, left: Disc and seats are parallel. No problem. Right: Seats out of parallel because of unequal expansion or contraction but discs adjust themselves to give positive closure. *Still* no problem! Radiused face of wedge allows discs to adjust tightly against both seats.

DARLING VALVE & MANUFACTURING CO.

Williamsport 19, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

For more data circle 578 on Post Card

Have you this LATEST DATA

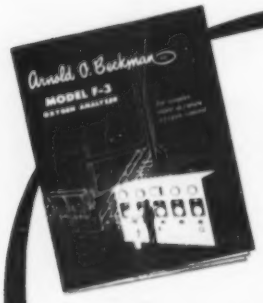
on the revolutionary

Arnold O. Beckman INC.

OXYGEN ANALYZERS?

Throughout industry — wherever oxygen content of gases influences or controls combustion or firing operations — Arnold O. Beckman Oxygen Analyzers are establishing completely new standards of accuracy, simplicity and convenience. These are the *only* instruments that make a direct physical measurement on oxygen itself — not of some variable secondary relationship.

Have *you* fully investigated the vital savings to be made by this revolutionary measuring principle in *your* operations? Are you aware of the latest money-saving applications for this equipment? If not, send for the following helpful literature. It's free!



BULLETIN 108: *Describes the Model F-3 Beckman Oxygen Analyzer —the instrument designed primarily for industrial applications such as combustion control, catalyst regeneration, sulfur grinding, etc., which requires an oxygen measuring range of 0-5%, 0-10%, 0-15% or higher. Bulletin 108 describes the unique magnetic operating principle used in Model F-3 Analyzers, gives equipment specifications and typical applications.*

BULLETIN AD607: *Contains helpful charts and data on most efficient methods of controlling various combustion processes.*

BULLETIN AD608: *Outlines savings to be made with oxygen control in Cat Cracking operations, gives sampling suggestions and list of equipment.*

BULLETIN AD611: *Contains helpful data on Tunnel Kiln Applications, shows typical installation, details equipment required.*

BULLETIN AD703: *Describes a Gas Sampling System particularly suited for combustion applications in various types of plants . . . illustrates layout of equipment, provides table for selecting sample tubes.*

The above informative literature will gladly be sent you free. For maximum convenience, use the coupon at right.

Arnold O. Beckman INC.

1020 Mission Street, South Pasadena 5, California

Please send Bulletins checked below:

☐ 108 ☐ 607 ☐ 608 ☐ 611 ☐ 703

Name _____

Company and Address _____

_____

_____

Position _____

For more data circle 579 on Post Card

which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

232 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are included. Beaumont Birch Co.

233 Fly Ash Elimination — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

PUMPS, PUMPING

234 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature available on each of them. Goulds Pumps, Inc.

235 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

236 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

237 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

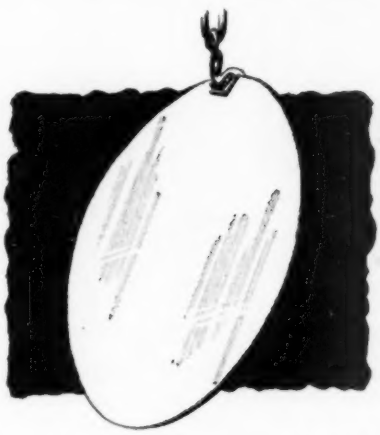
238 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Revere, like other companies, prefers to avoid rush orders, because they tend to upset orderly scheduling of production and shipment. However, we are not bound by system, and will do everything we can to help when a customer faces a genuine emergency. Sometimes, of course, in spite of the best will in the world, we encounter conditions beyond our control. A metal shortage is one example. But when there is an overwhelming need for speed sometimes we can meet it.

Let us cite a recent case. An important customer on the West Coast had spoiled two circular tube sheets while drilling them. This message was relayed by telephone to our New Bedford mill where we produce these sheets. How soon could we replace them? They were for an important government project. So urgent was the need that the customer offered to charter a plane to fly them to California as soon as they were ready.



A quick check showed that we could make duplicate sheets much more quickly than usual. The specified alloy was in stock, partially processed, so that casting time was eliminated, as well as some of the rolling. It was rolled down to the required gauge, 1⅛ inch thick, leveled, and cut into two circles, each 98 inches in diameter.

Meanwhile, the Traffic Department worked on the rather complicated problem of determining the fastest, most direct, yet least expensive way to get the circles to the Coast. Because of the weight and the time already saved, shipping by plane entailed a cost that didn't seem justified. Traffic reported that the best solution was to ship by "direct car," which guaranteed no extra handling or trans-shipping en route. This was agreed to by the customer, and four days after he called us, the circles were thus shipped. They arrived eleven days later, in time to meet the deadline.

Was the extra effort required to rush through 5,000 pounds of tube sheets justified? We are sure it was. Two days after the circles arrived we received a letter from the customer, in which he said: "The promptness with which your company undertook the problem of supplying the two sheets to replace those we had spoiled has been appreciated by all of us. . . . It is most heartening to work with persons who have a real sense of responsibility and concern over their customers' emergency requirements. Your company's performance in this instance left nothing to be desired and we want you to know that it meant a great deal to all of us."

As we have remarked, we do not relish rushes any more than anybody else, but when there is a situation of real gravity, we will do our best to cope with it. Other suppliers in all industries, we have observed, follow much the same policy, so we suggest that when a genuine emergency arises, tell your suppliers the exact nature of it and ask them what they can do for you. They may be able to find a way to help you, as Revere did in the case just cited.

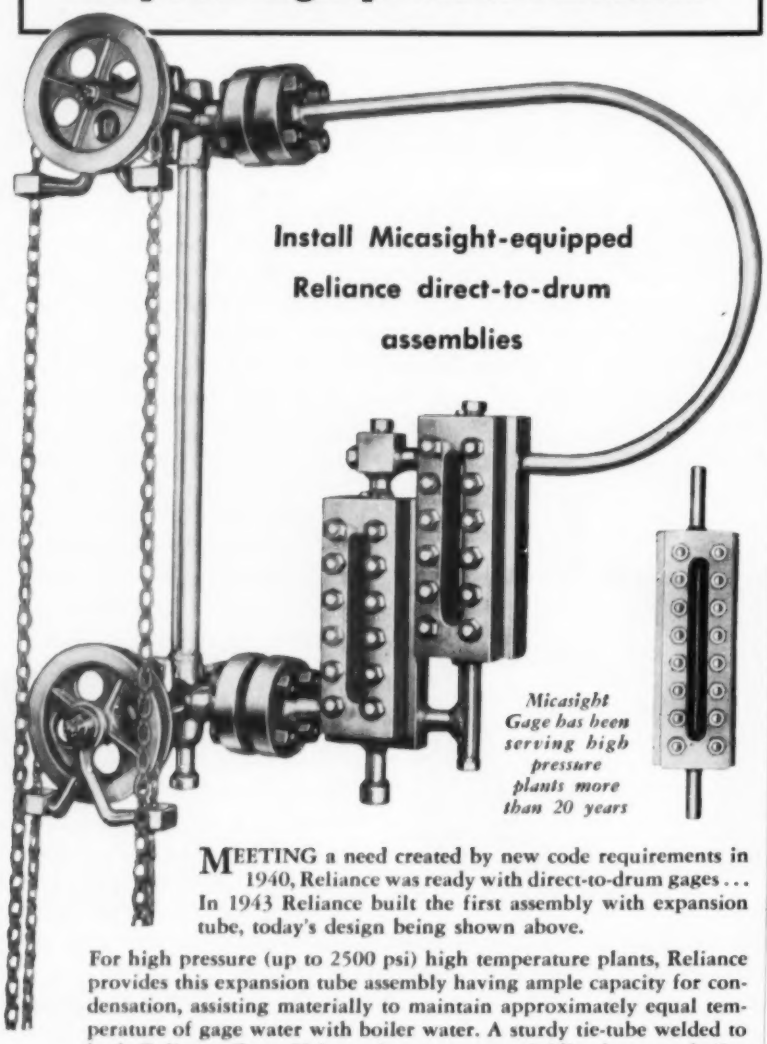
REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

***Executive Offices:* 230 Park Avenue, New York 17, N.Y.**

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

Stop gage glass breakage on your high pressure boilers


Install Micasight-equipped
Reliance direct-to-drum
assemblies
Micasight Gage has been serving high pressure plants more than 20 years

MEETING a need created by new code requirements in 1940, Reliance was ready with direct-to-drum gages . . . In 1943 Reliance built the first assembly with expansion tube, today's design being shown above.

For high pressure (up to 2500 psi) high temperature plants, Reliance provides this expansion tube assembly having ample capacity for condensation, assisting materially to maintain approximately equal temperature of gage water with boiler water. A sturdy tie-tube welded to both Reliance Gage Valves gives necessary rigidity between boiler connections. Reliance all-welded gage assemblies have more than sufficient ruggedness to meet severest conditions.

Extra gage-reading safety and long window life is assured by the exclusive Micasight Gage which uses non-shattering mica windows securely clamped in short, wide-bar, non-breathing bodies. Reliance provides access to clean out all passages, with entrances guarded by non-freezing plugs. Gage is connected to valves by ring-joint flanges — no nipples or packing glands. The Micasight is the safest water gage known. *Write for full information, to the factory or your nearest Reliance representative.*

RELIANCE GAUGE COLUMN CO., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance®

BOILER SAFETY DEVICES

For more data circle 581 on Post Card

PACKINGS, GASKETS, SEALS

239 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

240 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

BOILERS, GENERATORS

241 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

242 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

243 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

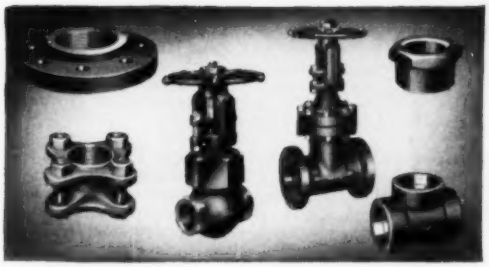
244 Steam Boilers — Form AD-100 is an 8-pp catalog providing complete description of company's self-contained boiler, hot water or steam, for heating and processing. Includes design details, capacities, dimensions and application information on boilers ranging from 15 to 500 hp and 15 to 250 psi. Cleaver-Brooks Co.

245 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

TUBING AND ACCESSORIES

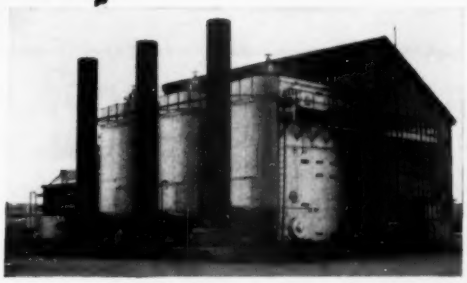
246 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifica-

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

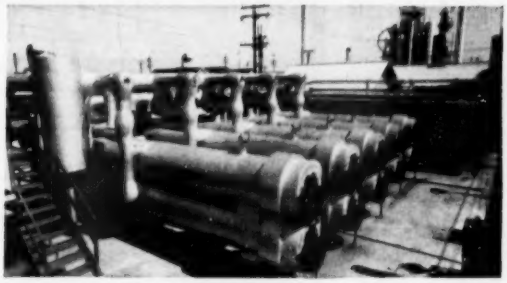


MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

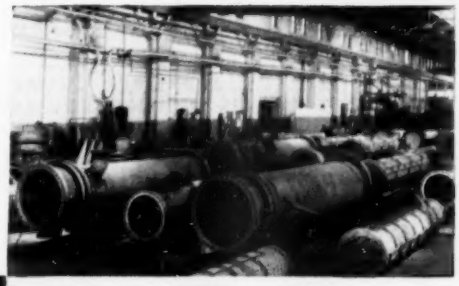
PROCESS EQUIPMENT FOR EVERY SERVICE

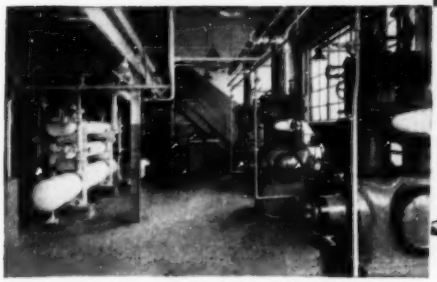
Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.





Vogt

PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

For more data circle 582 on Post Card

It will pay you to look into Bird-Archer's 8 Point Water Treatment Service.

1 PLANT SURVEY—Complete studies of your use of water or steam including equipment and past performance.

2 STUDY OF ALL AVAILABLE WATER—Exhaustive analysis of water supplies starting at source.

3 LABORATORY SERVICE FOR SCIENTIFIC ANALYSES—Modern laboratory facilities with seasoned chemists specializing in water analyses and research.

8 ENGINEERING SERVICES FOR WATER TREATMENT

For Power • For Process • For Cooling

BIRD-ARCHER WATER TREATMENT

THE BIRD-ARCHER COMPANY,
4337 NORTH AMERICAN ST.,
PHILADELPHIA 40, PA.
NEW YORK • CHICAGO

IN CANADA:
The Bird-Archer Co., Limited, Cobourg, Ontario

IN MEXICO:
Calderas y Accesorios, S.A., Amsterdam 291, Mexico, D. F.

4 DEVELOPMENT OF TREATMENT AND CONTROL SYSTEMS—Operational changes where necessary.

5 FURNISHING PROPER CHEMICAL TREATMENTS WHEN REQUIRED—Bird-Archer custom formulates chemical treatments for your specific problems. Over 60 years background.

6 SPECIFICATION AND FURNISHING OF EQUIPMENT WHEN NECESSARY—Complete analysis of savings and benefits where additional equipment may be helpful.

7 PLANT STAFF INSTRUCTION—Your personnel instructed by experienced technicians in accurate control and test procedures.

8 PERIODIC CHECK-UPS—Your Bird-Archer Service Engineer makes regular personal call-backs on your plant to be sure you get the best possible results.

BA-902

FOR COUNSEL BACKED BY OVER SIXTY YEARS OF EXPERIENCE CALL BIRD-ARCHER'S QUALIFIED WATER TREATMENT ENGINEERS. CONSCIENTIOUS, PERSONAL ATTENTION AND HIGHEST QUALITY CHEMICALS.

Engineering Plus Chemistry Equal BIRD-ARCHER Service

For more data circle 583 on Post Card

tions, conversion tables, and weights. Scovill Mfg. Co.

247 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

248 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

249 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

250 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

251 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

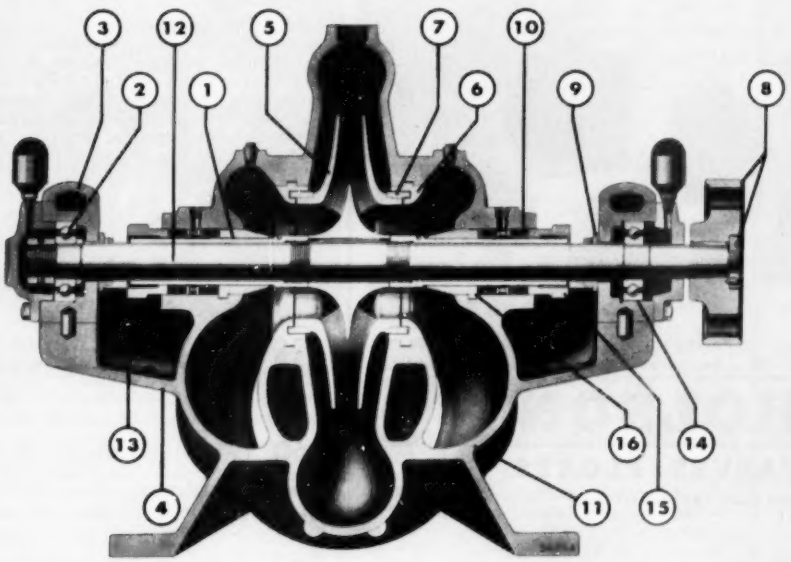
252 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

253 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

254 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

DE LAVAL
SINGLE STAGE CENTRIFUGAL PUMPS

for dependable industrial service



Labyrinth wearing rings minimize leakage...maintain high efficiencies

Labyrinth rings used in these De Laval pumps retard flow of water through labyrinth passage.

Flat rings showing relatively unimpeded flow of water.

(1) **Shaft Sleeves** are screwed on, to abut the impeller and make a water-tight joint. Sleeve expands freely and independently of shaft when temperatures change. There is no tendency to buckle.

(2) **Thrust Bearing** locates rotor axially.

(3) **Bearing Caps** easily removable for maintenance.

(4) **Bearing Brackets** scraped to lining bars for perfect alignment.

(5) **Impeller** hydraulically balanced, finished on all surfaces.

(6) **Labyrinth Wearing Rings** held accurately in machined grooves in both case and cover.

(7) **Impeller Wearing Rings** threaded on impeller, opposite to rotation.

(8) **Flexible Coupling** ground on all exposed surfaces and statically balanced, complete coupling supplied, pump half mounted on taper so that it can be easily removed. Check nut locks coupling on taper.

(9) **Deflector** keeps water out of bearing.

(10) **Stuffing Boxes** extra deep; lantern rings for water sealing.

(11) **Pump Case** horizontally split; machined to limit gages.

(12) **Steel Shaft** ground to limit gages.

(13) **Drip Boxes** large; provided with drain openings.

(14) **Radial Bearing** free to move axially, thus avoiding temperature strains.

(15) **Glands** split horizontally.

(16) **Protecting Bushings** renewable.

You can count on the performance of the De Laval Single Stage Centrifugal Pumps because they are precision-made to high manufacturing standards and incorporate the many quality design features shown in the cross-section.

They operate at high or low speeds, at high or low heads...with maximum efficiency.

For example, De Laval G, I and K Single Stage Double Suction Pumps have a capacity range of 175 gpm to 6,000 gpm, and heads to 300 feet. They are available in sizes ranging from 4" suction and 3" discharge to 14" suction and 12" discharge. Write for Bulletin 1002.

DeLaval also furnishes larger centrifugals for capacities up to 70,000 gpm.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

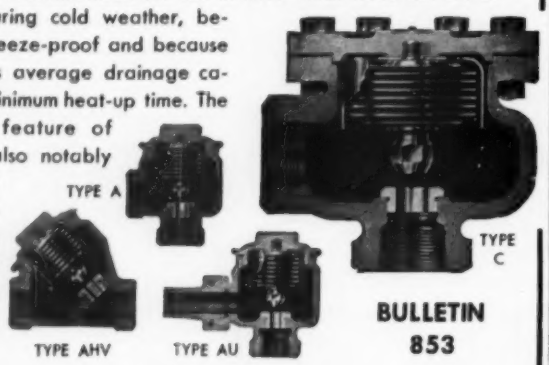
For more data circle 584 on Post Card

NICHOLSON MAKES

Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2"; pressures to 250 lbs.



BULLETIN 853

160 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

For more data circle 585 on Post Card

Pure zinc or aluminum, molten-sprayed on iron or steel surfaces, provides complete, dependable protection against atmospheric corrosion for upwards of 20 years without further maintenance. Such coatings are *mechanically* bonded to the surface—adhesion is *not* dependent on volatile vehicles or binders. Scaling, crazing, blisters, are eliminated. Protection is positive. "Metallize 'em and forget 'em!"

Why not find out more about how you can forget rust for 20 years or more? For descriptive Bulletin 62B—or the name of your nearest Metco Systems contractor—write or wire.

**Reg. U.S. Pat. Off.*

the Metco* Systems
—a series of 18 basic engineering specifications developed over 19 years of experience with pure zinc and aluminum coatings on many different types of structures and equipment. The *Metco Systems* provide for standardization of surface preparation, metal coating thicknesses and organic aftercoatings for various service conditions and appearance requirements.

Metco Systems Dept. PE, 38-14 30th Street Long Island City 1, New York

For more data circle 586 on Post Card

255 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

256 Pressure Reducing Valve — Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve designed for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation. McAlear Mfg. Co.

257 Butterfly Valves — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 359 covers those of standard heavy-duty construction; Bulletin 358, 8 pp, those of standard medium-duty construction; and Bulletin 359, rubber-lined butterfly valves. W. S. Rockwell Co.

258 Regulating Valves — Bulletin 313 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

259 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

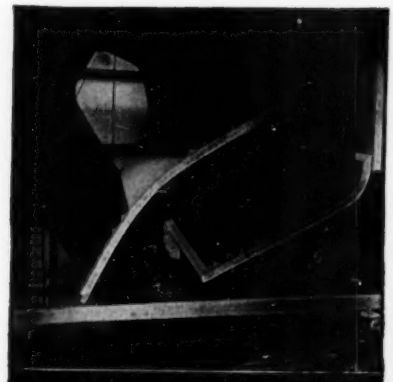
260 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

261 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

262 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

263 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

264 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size con-



Streamlining
SAVES PRECIOUS FUEL

STREAMLINE the flow of gases across the boiler tubes and you get more steam from less fuel. That is what Enco Baffles do. They use scientifically curved baffle surfaces instead of sharp angles. They taper the passes to maintain velocity as the gases decrease in volume, which promotes heat-transfer. They:

- Eliminate bottle-necks
- Abolish dead gas pockets
- Reduce draft losses
- Speed heat transfer
- Keep heating surfaces cleaner
- Cut down use of soot blower
- Provide for tube expansion and replacement

Adaptable to any type of water-tube boiler, fired with any fuel. Designed for each individual installation. Only selected materials used. Installed by skilled mechanics. Send for Bulletin BW 44.

THE ENGINEER COMPANY
75 West Street, New York 6, N. Y.

Enco
Streamline Baffles
Produced exclusively by The Engineer Co

For more data circle 587 on Post Card

densate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

265 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

266 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

WATER CONDITIONING

267 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

268 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

269 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

OTHER EQUIPMENT

270 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

271 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

272 Fast Hard Surfacing — Bulletin 53B presents some applications of the Sprayweld process which combine metal-

Close-up view of leaf-type filter used with Sorbo-Cel by Pullman-Standard

How Pullman-Standard operates boilers on a

1% blow-down basis...

with SORBO-CEL

At the Haskell & Barker plant of Pullman-Standard Car Mfg. Co., Sorbo-Cel solved the major filtration problem of removing oil from condensate returned to the two new 50,000 lb-per-hr 400 psi, 750-F boilers.

Pre-Coat Sorbo-Cel and regular Sorbo-Cel, specially processed high flow-rate diatomaceous silica powders, are used on leaf-type filters. After a film of Pre-Coat Sorbo-Cel has been built up on the filter screens, regular Sorbo-Cel is added continuously to the unfiltered water. This means a new filter surface is constantly presented to the oncoming water.

Results . . . Water filtered by Sorbo-Cel contained less than 0.1 ppm of oil . . . and boilers have since been operated on a *one per cent* blow-down basis.

Send coupon below for bulletin giving data on this low-cost way to remove oil from water. No cost or obligation.

Johns-Manville
SORBO-CEL

Johns-Manville
Box 60, New York 16, N. Y.

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

For more data circle 588 on Post Card

spraying and torch-fusing for simplified, high-speed hard-surfacing. Cites use of this process on acid sludge pump rods, on guide rolls at a steel rolling mill, on deep-well irrigation pump rods and agitator shafts. Metallizing Engineering Co., Inc.

273 Why Fully Crowned Teeth — Seven major engineering advantages of fully crowned teeth in gear type flexible couplings, are described in Bulletin 1052. Applications of Amerigear couplings for the solution of power transmission problems such as excessive offset or angular misalignment and space limitations described. American Flexible Coupling Co.

274 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

275 Communication Systems — Sixteen-pp Form P831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated in these systems are covered in detail. RCA Victor Div., Radio Corp. of America.

276 Hydraulic Equipment — Circular 50-A, 6 pp, describes and pictures hydraulic jacks, hydraulic high-pressure and test pumps, and hydraulic units for forcing, pressing, pulling etc. Includes application suggestions, material specifications, capacities. Richard Dudgeon Inc.

277 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

278 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • RICHMOND, VA. • RALEIGH, N. C.

For more data circle 590 on Post Card

J. E. SIRRINE COMPANY
Engineers
Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog
LIVINGSTON, N. J.

GAUGE JITTERS PREVENTED
with CAMPBELL
MICRO BEAN

Jitters are destructive
Micro-Bean protects gauge

A UNIVERSAL PULSATION DAMPENER

Solve pulsation problems on gauge and governor lines. Micro-Bean instantly adjusts to compensate in viscosity and surface tension. Will not score out. Jitters in gauges positively eliminated. Any line subjected to pulsation flow can be stabilized with Micro-Bean. Will multiply life of gauges by ten. Demanded by hundreds of engineers. More than 8000 used in World War II on portable fuel and water lines. An absolute necessity in many power plants. Can be used on any gauge line to boilers, engines, pumps and compressors. ¼" and ½", pressures to 10,000 lb. Write for literature and prices.

J. A. CAMPBELL CO.
645 E. Wardlow Rd. Long Beach 7, Calif.

For more data circle 589 on Post Card

KOR

FUEL OIL CONDITIONER
pronounced "core"
IT'S SO DIFFERENT
FROM ANY OTHER ADDITIVE
A FORMULAE PATENT HAS BEEN APPLIED FOR

KOR conditions all grades of fuel oil as well as pitch and coal tar

IT'S A COMBUSTION-TYPE COMPLETE TREATMENT
- ALKALINE AND REALLY SAFE TO USE
- COMPLETELY MISCIBLE WITH ALL GRADES OF OIL
- WILL NOT CAUSE ACID PRODUCTS IN STORAGE TANKS
- WILL NOT PRODUCE HYDROCHLORIC ACID IN FURNACES
- KEEPS ALL BOILER HEATING SURFACES CLEAN
- HELPS TO OBTAIN MORE STEAM WITH LESS FUEL

YOU'VE HEARD ABOUT IT . . . YOU'VE READ ABOUT IT
TRY IT

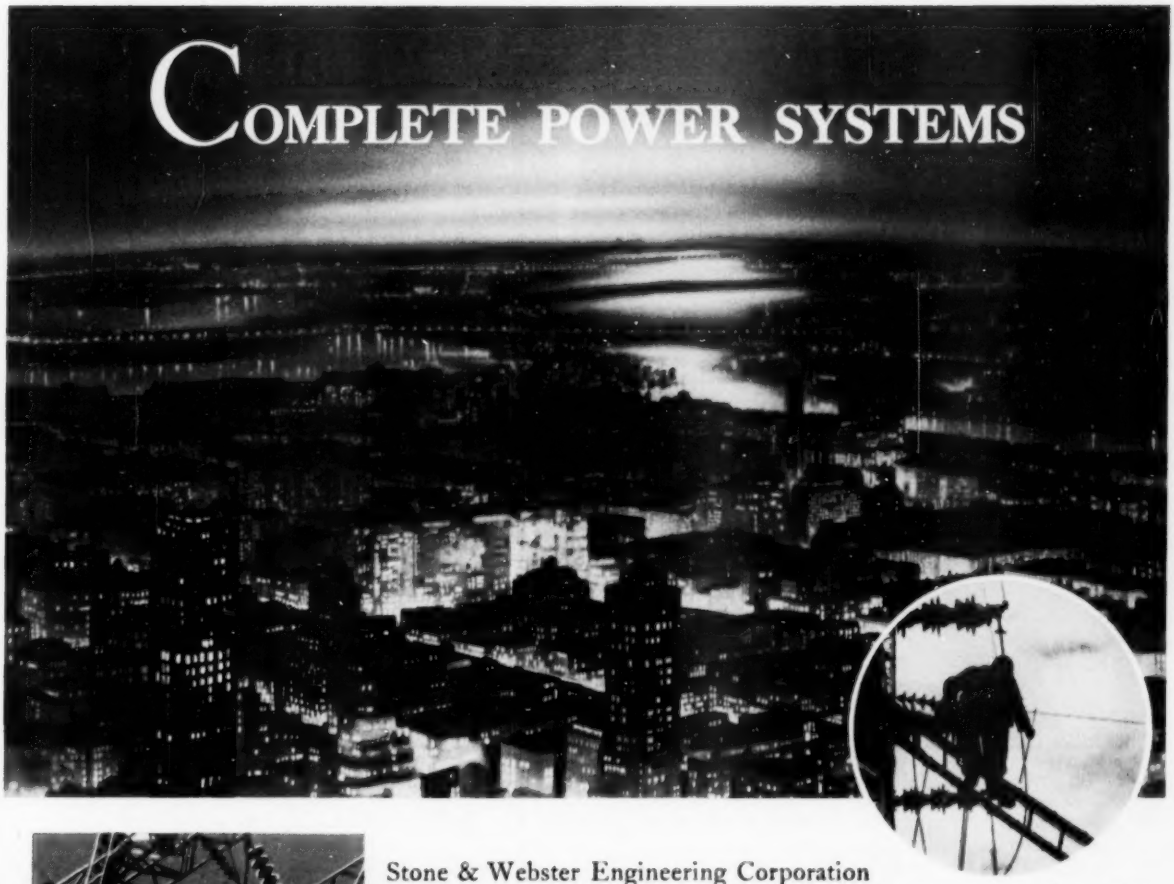
IT'S THE BEST

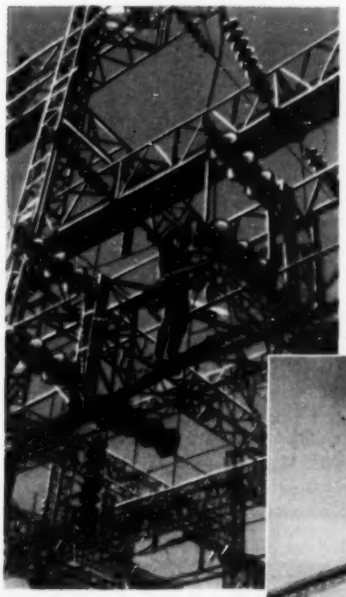
INQUIRIES FROM MANUFACTURERS AGENTS INVITED

KOR CORPORATION
Division of Oxi Corporation
MANUFACTURING, ENGINEERING, AND COMBUSTION SPECIALISTS
600 WEST 9th AVENUE, GARY, INDIANA

For more data circle 591 on Post Card

COMPLETE POWER SYSTEMS





Stone & Webster Engineering Corporation has many years' experience in the design and construction of complete power systems to serve industries or entire communities.

The Corporation's service includes the initial planning of the system; forecast of loads; design and construction of generating units; transformer facilities; switching distribution; location and construction of transmission lines and substations; interconnection; and the determination of equitable rates.

This experience is available for any phase of the design and construction of power systems.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

For more data circle 592 on Post Card

40 PAGES of helpful information

on Recovering Dusts, Fly Ash, Mists, Fumes and other Suspensions from Gases.

This booklet summarizes

the important points design and plant engineers should know about Cottrell Precipitators . . .

- **Basic types of Cottrell equipment.**
- **Principal elements in a Cottrell unit.**
- **Data on Mechanical and Electronic Rectifiers.**
- **Various types of Collecting Electrodes (rod curtains, corrugated plates, pocket electrodes, etc.).**
- **Typical ways of removing collected material.**
- **Various Shell Constructions (steel, concrete, brick, etc.).**
- **The effect of various factors on efficiency and performance.**
- **Data on CMP (Combination Multiclone-Precipitator) Units.**

. . . and many other helpful facts on Cottrell design and operation.

Latest data from Western Precipitation on Cottrell Recovery Equipment

Do you have operations in your plant where gas-laden suspensions, wet or dry, are a problem? Such suspensions may be dropping on surrounding property, causing nuisance difficulties. Or perhaps important values are being lost in stack gases that can be profitably recovered. Whatever the nature of your recovery requirements, you will find this 40-page Cottrell booklet of great help. It contains up-to-date data on the latest advancements in the electrical precipitation field – prepared by the organization that pioneered the commercial application of Cottrell Electrical Precipitators almost a half century ago and has consistently led in new Cottrell developments.

A copy of this data-packed booklet will be sent free to engineers and other executives interested in recovery processes. Send your request to our nearest office.

For nearly 50 years Western Precipitation has carried on a continuous research and development program on Cottrell Electrical Precipitators, Multiclone Mechanical Collectors and other types of recovery equipment. We are not affiliated with any other company in the electrical precipitation field except our wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. We are equipped to serve you anywhere in the United States, Canada, and throughout the world!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

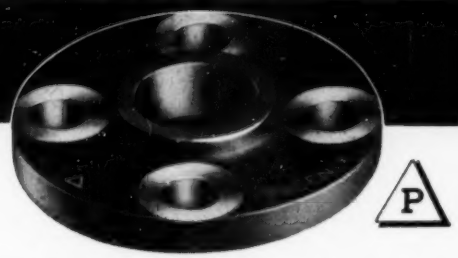
Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 N. LaSALLE ST. BLDG., CHICAGO 2
1429 PEACHTREE ST. N.E., ATLANTA 5 • HOBART BUILDING, SAN FRANCISCO 4 • PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

For more data circle 593 on Post Card

For more data circle 594 on Post Card

PHOENIX *Drop-Forged* FLANGES MEAN...

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

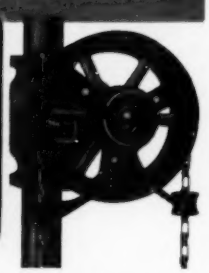
NEW CATALOG!

Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

NOW! Tougher, Stronger with MEEHANITE IRON

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide



Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims—also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide—

- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

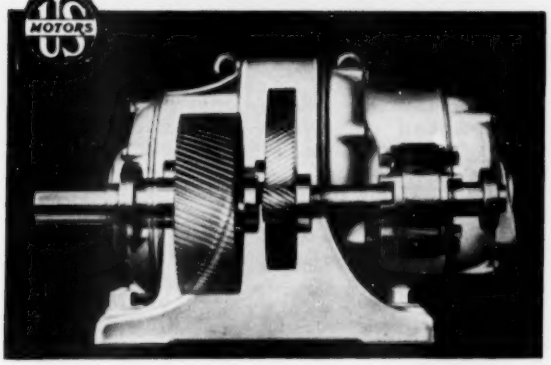
Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.
4 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS

For more data circle 595 on Post Card

Geared Power
SIMPLIFIED WITH
SYNCROGEAR



The motor that internally gears its speed

DON'T go to the expense of installing a gear box with extra coupling and guards to rig up slow speed for a motor. Install the *U.S. Syncrogear motor* and avoid extra contraptions. You'll simplify your power hook-up, save space, eliminate hazards and give your driven machine the most efficient power. The U.S. Syncrogear motor was one of the first complete integral power units, introduced 22 years ago. It's backed by experience, tested and proved performance and engineering "know-how" that only U.S. MOTORS can offer to those seeking the most dependable geared motor power.

SYNCROGEAR ADVANTAGES

Compact—rugged—quiet
No external gear box
No extra coupling
Internally-geared
Single unit on one base
Completely housed
Reduced frictional losses
Permanently-aligned parts
Super-hardened gears
Pyramidal supporting base
Solid shank pinion
Normalized castings
Extra large oil reservoir
Asbestos-protected windings
In-a-line shaft
Neat, streamline appearance
Drip-proof surface

U.S. SYNCROGEAR MOTOR *4 TO 10,000 RPM. 1/4 TO 30 H.P.*

REQUEST FOR SYNCROGEAR MOTOR BOOKLET

U. S. ELECTRICAL MOTORS INC. PE-2
Box 2058, Los Angeles 54, Calif.
or Milford, Conn.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

For more data circle 596 on Post Card

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy UNIONS

Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS

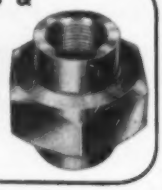
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS

With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS

With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



WRITE FOR CATALOG 11
showing the complete Catawissa line of Perfect Seal Products

CATAWISSA VALVE AND FITTINGS COMPANY
400 Mill St. • CATAWISSA, PA.

ADVERTISERS INDEX

When writing to advertisers for information please tell them you saw their ad in Power Engineering—or use the handy post card on "Bulletins" insert in this issue.

ALLIS-CHALMERS MFG. CO. 44–45, 99, 125
Agency—Compton Advertising Inc.
ALLIS-CHALMERS MFG. CO. (TRACTOR DIV.) 16
Agency—Bert S. Gittins Advertising
AMERICAN CHAIN AND CABLE CO., AUTOMOTIVE & AIRCRAFT DIV. 108
Agency—Reincke, Meyer & Finn, Inc.
AMERICAN CHIMNEY CORP. 144
AMERICAN FLEXIBLE COUPLING CO. 115
Agency—The Lee Donnelley Co.
AMERICAN MACHINE & METALS INC., THE 7
Agency—L. W. Ramsey Advertising Agency
AMERICAN PULVERIZER CO. 20
Agency—Batz-Hodgson-Neuwoehner
ANDERSON, V. D. CO., THE 126
Agency—Will Inc.
ARMSTRONG MACHINE WORKS 2
Agency—Russell T. Gray, Inc.

BABBITT STEAM SPECIALTY CO. 147
Agency—George T. Metcalf Co.
BABCOCK & WILCOX CO., THE 10–11
Agency—O. S. Tyson and Co., Inc.
BAILEY METER COMPANY 149
Agency—Fuller & Smith & Ross, Inc.
BALDWIN-HILL CO. 120
Agency—Eldridge, Inc.
BALTIMORE & OHIO RR. 39
Agency—Richard A. Foley, Inc.
ARNOLD O. BECKMAN, INC. 136
Agency—Dozier-Eastman and Co.
BETZ, W. H. & L. D. 97
Agency—The Michener Co.
BIDDLE CO., JAMES G. 111
Agency—The Roland G. E. Ullman, Inc.
BIGELOW COMPANY ..... *
Agency—Emil Mark & Co.
BIRD-ARCHER CO., THE 140
Agency—The Roland G. E. Ullman, Inc.
BITUMINOUS COAL INSTITUTE 53
Agency—Benton & Bowles, Inc.
BRIDGEPORT BRASS CO. 127
Agency—Hazard Advertising Company

CAMBRIDGE INSTRUMENT CO., THE 128
Agency—E. M. Freystadt Associates, Inc.
J. A. CAMPBELL CO. 144
Agency—The McCarty Co.
CATAWISSA VALVE & FITTINGS CO. 148
Agency—Charles E. Williams Advertising
CHAPMAN VALVE MFG. CO., THE ..... Inside Back Cover
Agency—Sutherland-Abbott
CHESAPEAKE & OHIO RAILWAY 98
Agency—Robert Conahay, Inc.
CITIES SERVICE OIL CO. 103
Agency—Ellington & Company, Inc.
CLEAVER-BROOKS COMPANY (BOILER DIV.) 21
Agency—Klau-Van Pietersom-Dunlap, Inc.
COMBUSTION ENGINEERING, INC. 34–35
Agency—G. M. Basford Company
COPES-VULCAN DIVISION, CONTINENTAL FOUNDRY & MACHINE COMPANY 122
Agency—Davies and McKinney
CRANE CO. 37
Agency—The Buchen Company

DARLING VALVE & MFG. CO. 135
Agency—Griswold-Eshleman & Co.
DART UNION CO. 113
Agency—Sutherland-Abbott
DEARBORN CHEMICAL COMPANY 106–107
Agency—The Buchen Company
DE LAVAL SEPARATOR CO., THE 17
Agency—Donahue & Coe, Inc.
DE LAVAL STEAM TURBINE CO. 141
Agency—Michel-Cather, Inc.
DETROIT STOKER COMPANY ..... *
Agency—Witte & Burden
DOWELL INCORPORATED 25
Agency—MacManus, John & Adams, Inc.

EDWARD VALVES, INC. 46–47
Agency—Marstetter, Gebhardt & Reed, Inc.
ELLIOTT CO. ..... Inside front cover
Agency—Peterson & Kempner, Inc.
ELLISON DRAFT GAGE CO. ..... *
Agency—Tri-State Advertising Co., Inc.
ENGINEER CO., THE 143
Agency—Michel-Cather, Inc.
ERIE CITY IRON WORKS 18–19
Agency—Davies and McKinney
EVERLASTING VALVE CO. ..... *
Agency—Michel-Cather, Inc.

FULLER COMPANY 52
Agency—O. S. Tyson and Company, Inc.

GENERAL CABLE CORP. 110
Agency—Hicks & Greist, Inc.
GENERAL ELECTRIC COMPANY 12–13, 48–49, 116
Agency—G. M. Basford Company
GRINNELL CO., INC. 119
Agency—Horton-Noyes Company
GULF OIL CORP. 14–15
Agency—Young & Rubicam, Inc.
GUSTIN-BACON MFG. CO. 117
Agency—Valentine-Radford

HAGAN CORPORATION ..... *
Agency—Ketchum, MacLeod & Grove, Inc.
HALL LABORATORIES, INC. 112
Agency—Ketchum, MacLeod & Grove, Inc.

INSTROF INC. 118
Agency—R. E. Lovekin Corp.
INTERNATIONAL NICKEL COMPANY, INC., THE 101
Agency—Marschalk & Pratt Co.

JOHNS-MANVILLE 104, 143
Agency—J. Walter Thompson Company

KIRK & BLUM MFG., CO., THE 131
Agency—S. C. Baer Co.
KOR CORPORATION 144

LESLIE CO. 133
Agency—Mercready, Handy & Van Denburgh

MANNING, MAXWELL & MOORE, INC. 102
Agency—Fuller & Smith & Ross, Inc.
McALEAR MFG. CO. 121
Agency—Charles O. Puffer
METALLIZING ENGINEERING CO., INC. 142
Agency—Schuyler Hopper Co.
MILTON ROY CO. 26
Agency—Harris D. McKinney, Inc.
MINNEAPOLIS-HONEYWELL REG. CO. 54–55
Agency—The Aitkin-Kynett Co.

NATIONAL AIROIL BURNER COMPANY, INC. 114
Agency—R. E. Lovekin Corp.
NATIONAL ALUMINATE CORPORATION 22
Agency—Armstrong Advertising Agency
NICHOLSON & CO., W. H. 142
Agency—Wilbur A. Myers

PACIFIC PUMPS, INC. 105
Agency—The McCarty Co.
PHOENIX MFG. CO. 147
Agency—The Buchen Co.
PICK MANUFACTURING CO. 128
Agency—Ramsthal Advertising Agency
POWELL VALVES 109
Agency—The Ralph H. Jones Co.
PREFERRED UTILITIES MFG. CORP. 100
Agency—Spooner & Kriegel
PROPORTIONEERS, INC. 4
Agency—Hammond-Goff Co.

RADIO CORPORATION OF AMERICA 132
Agency—J. Walter Thompson Co.
RELIANCE GAUGE COLUMN COMPANY 138
Agency—Carr Liggett Advertising, Inc.
REPUBLIC FLOW METERS CO. 32–33
Agency—Glenn, Jordon, Stoetzel, Inc.
REVERE COPPER AND BRASS, INC. 137
Agency—St. Georges & Keyes, Inc.
RICHARDSON SCALE CO. 124
Agency—O. S. Tyson and Company, Inc.
RIC-WIL CO., THE 134
Agency—Ritchie & Sattler, Inc.
W. S. ROCKWELL CO. 28
Agency—Spooner & Kriegel
ROTO DIV. OF ELLIOTT CO. 30
Agency—Jos. S. Vogel & Co.

SCHUTTE & KOERTING 31
Agency—Harris D. McKinney, Inc.
SCOVILL MFG. CO. 27
Agency—Edward W. Robotham & Co.
SINCLAIR REFINING CO. 29
Agency—Morey, Humm & Johnstone, Inc.
STEPHENS-ADAMSON MFG. CO. 43
Agency—Glenn-Jordan-Stoetzel, Inc.
STONE & WEBSTER ENGINEERING CORPORATION 145
Agency—Harold Cabot & Co., Inc.

TEXAS CO., THE ..... Back Cover
Agency—Erwin, Wasey & Company, Inc.

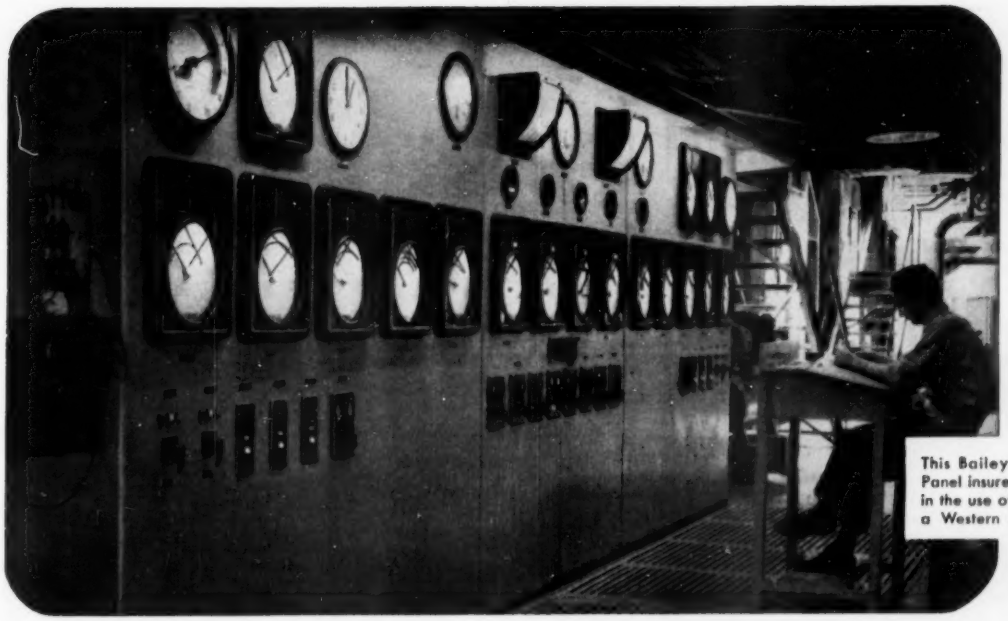
U. S. ELECTRICAL MOTORS, INC. 147
Agency—The McCarty Co.
UNITED STATES RUBBER COMPANY 150
Agency—Fletcher D. Richards, Inc.

VOGT MACHINE CO., HENRY 139
Agency—Farson & Huff

WATSON-STILLMAN CO. 41
Agency—W. L. Towne Advertising
WESTERN CHEMICAL COMPANY 123
Agency—Carter Advertising Agency, Inc.
WESTERN PRECIPITATION CORP. 146
Agency—Dozier, Eastman & Co.
WILSON, INC., THOMAS C. 128
Agency—Michel-Cather, Inc.
WING MFG. CO., L. J. 50–51
Agency—Willard G. Myers Advertising Agency

YARNALL-WARING COMPANY 8–9, 56
Agency—The Michener Co.

For more data circle 597 on Post Card



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METERS

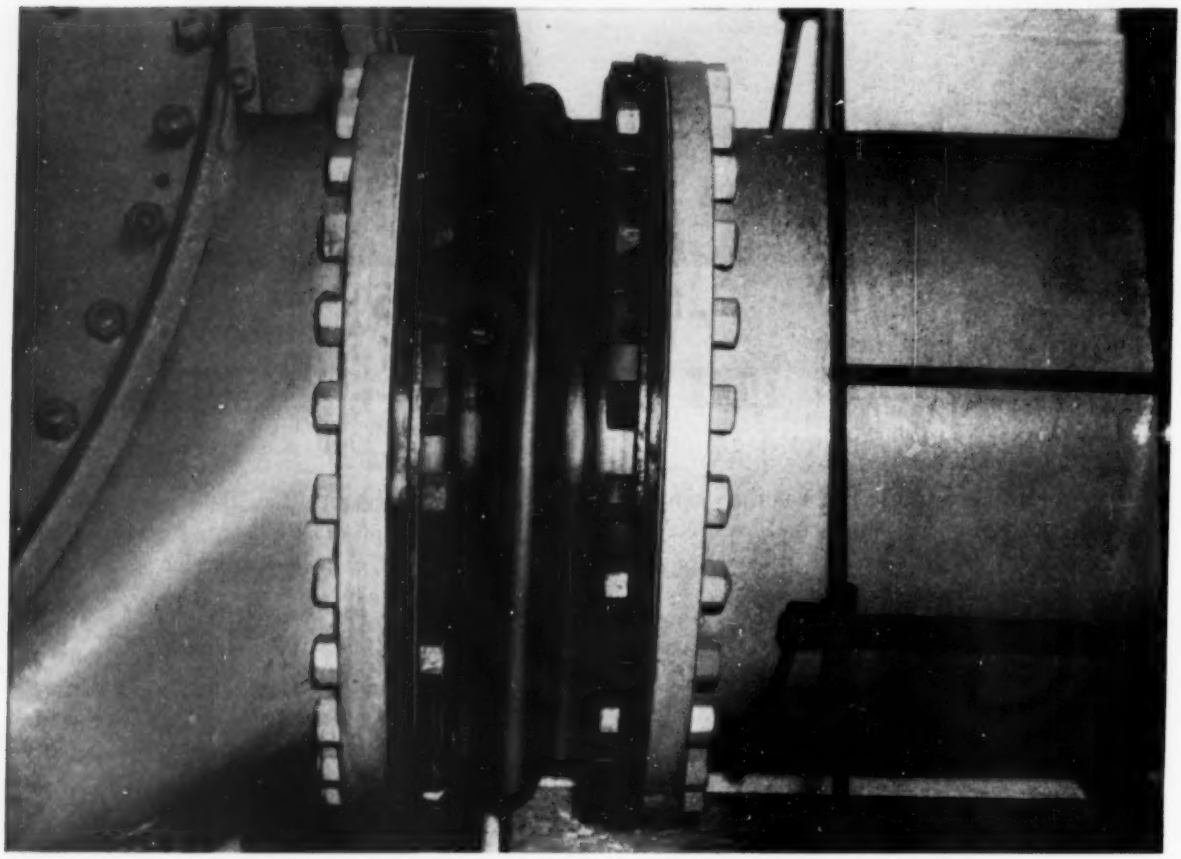
BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 598 on Post Card

28 years old... but there's a lot of life in the old joint!



Back in 1926, this 30" x 12" U. S. Expansion Joint was installed in a Louisiana power plant. This rubber joint is still in fine working condition. Age has not impaired its efficiency. Three other U. S. Joints in this plant are the same age, are still performing well... and one of them has been used continuously in the valve end inlet header water circulation line in a *very moist location.* Our service engineers report it has many more years of fine service still ahead!

In United States Rubber Company's Expansion Joint Line are standard types to meet the majority of general industrial requirements on pressure or vacuum lines—insulating against vibration, compensating for expansion or contraction. Joints can also be designed and built to meet your own specifications. You can always rely on U. S. Expansion Joints to lengthen the life of equipment, save many times their original cost.

Get in touch with any of United States Rubber Company's 25 strategically located District Sales Offices, each staffed with engineers to serve you, or write to address below.

U.S. RUBBER
SERVING THROUGH SCIENCE

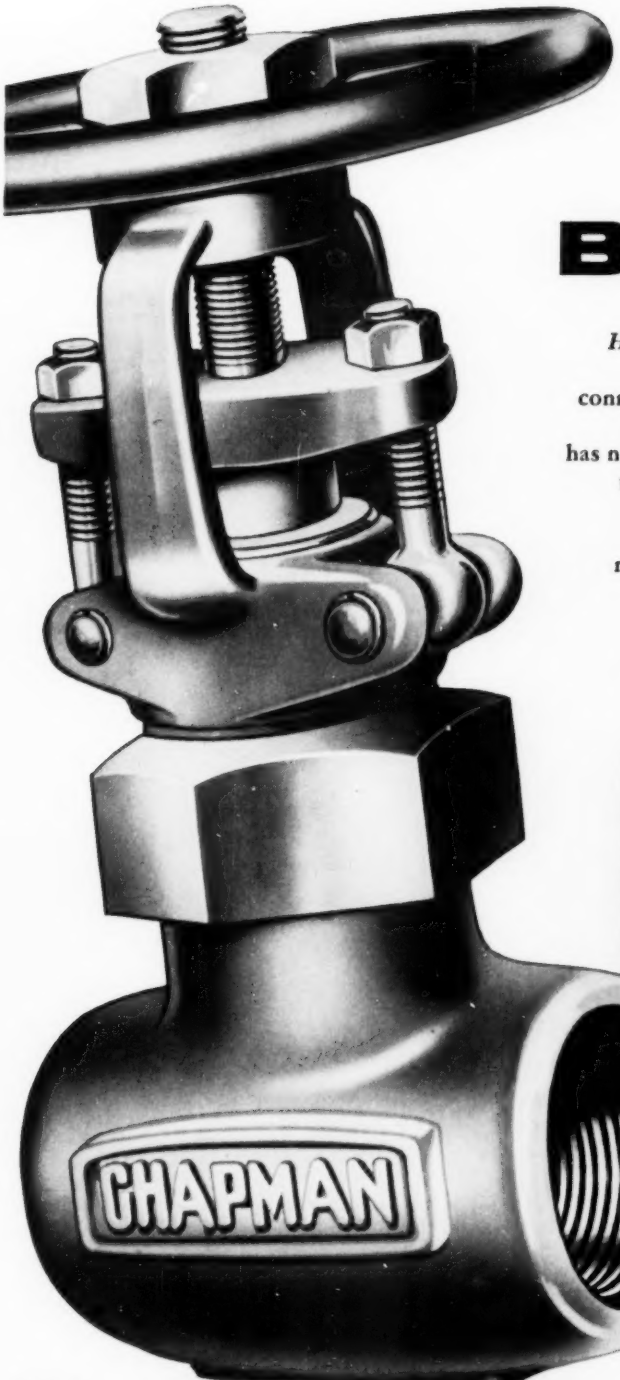
"U.S." Research perfects it
"U.S." Production builds it
U. S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

For more data circle 599 on Post Card



The Small Valve

THAT DOES THE

BIG JOB

Here's what you get: Extra protection against excessive stress with new extra-strong stem and wedge-gate connection . . . super-hardened seat rings of stainless steel . . . forged body and yoke (and bolted follower that has no threads to corrode) . . . plus Malcomized gate faces that won't seize or gall. Made in sizes from ½" to 2" inclusive, with choice of rising stem with yoke, or with inside screw. Bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F. For higher pressures, specify List 990. Write for Catalog 10.

The CHAPMAN VALVE MFG. COMPANY

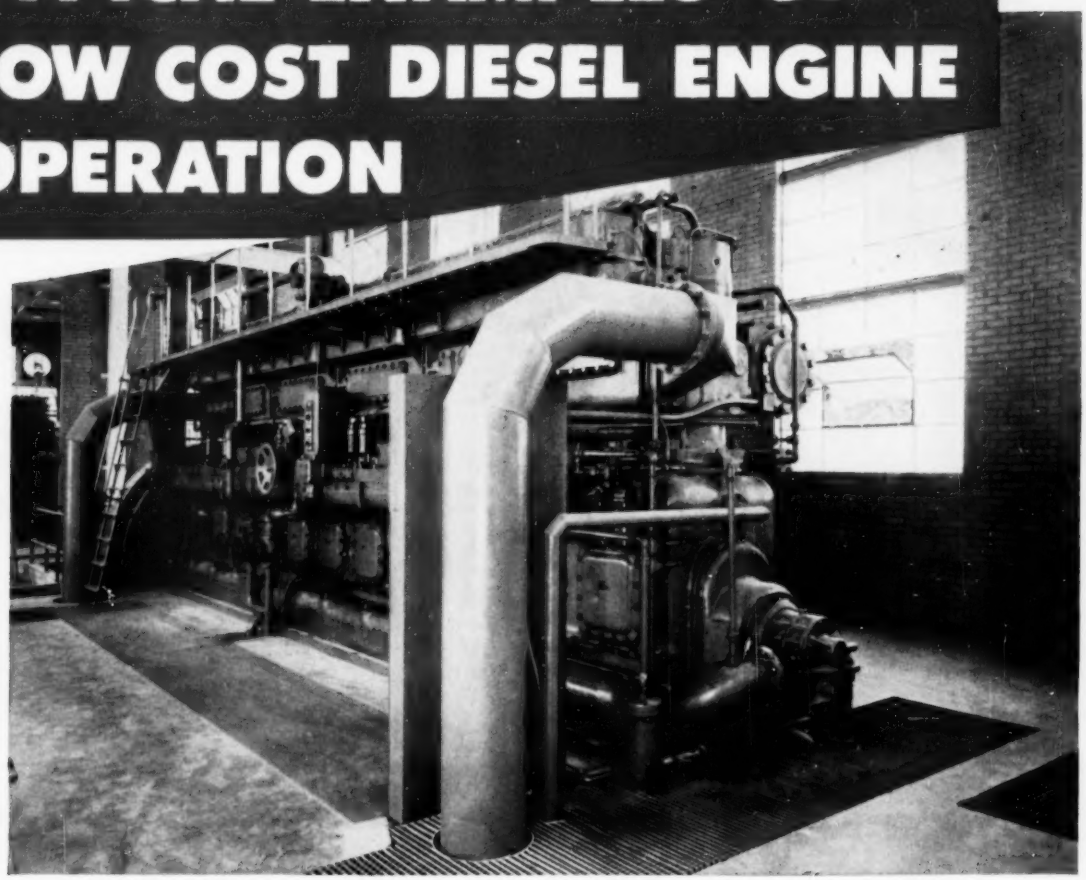
INDIAN ORCHARD, MASS.

LIST 960

CHAPMAN

For more data circle 600 on Post Card

TYPICAL EXAMPLES OF LOW COST DIESEL ENGINE OPERATION



...with TEXACO URSA OILS

In plants everywhere, Diesels lubricated with the recommended member of the famous *Texaco Ursa Oil* series are turning in outstanding records for low maintenance costs and economical fuel consumption. For example, (names on request) —

Tulia, Texas: Has been using *Texaco* for 20 years, never had a stuck ring. Wear has been slight, maintenance costs very low.

Sioux Falls, South Dakota: Engine in service 96 per cent of time for 14 years, has generated over 71 million kwh. at the rate of 12.16 kwh. per gallon of fuel consumed.

McGregor, Iowa: Ten-year records show 12,469 h.p. hours per gallon of lube oil. Engines stay clean, with no measurable wear.

Weatherford, Texas: Yearly inspections show cylinder wear less than .001" per thousand hours, no detectable bearing wear. Original rings still in use.

The *Texaco Ursa Oil* series is *a complete line* of Diesel lubricating oils especially refined to make Diesel, gas and dual-fuel engines give *more power* with *less fuel* over *longer periods* between overhauls. That is why —

For more than twenty years, more stationary Diesel horsepower in the United States has been lubricated with Texaco than with any other brand.

Let a Texaco Lubrication Engineer help you. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

TUNE IN . . . METROPOLITAN OPERA radio broadcasts every Saturday afternoon. See newspaper for time and station.

For more data circle 601 on Post Card